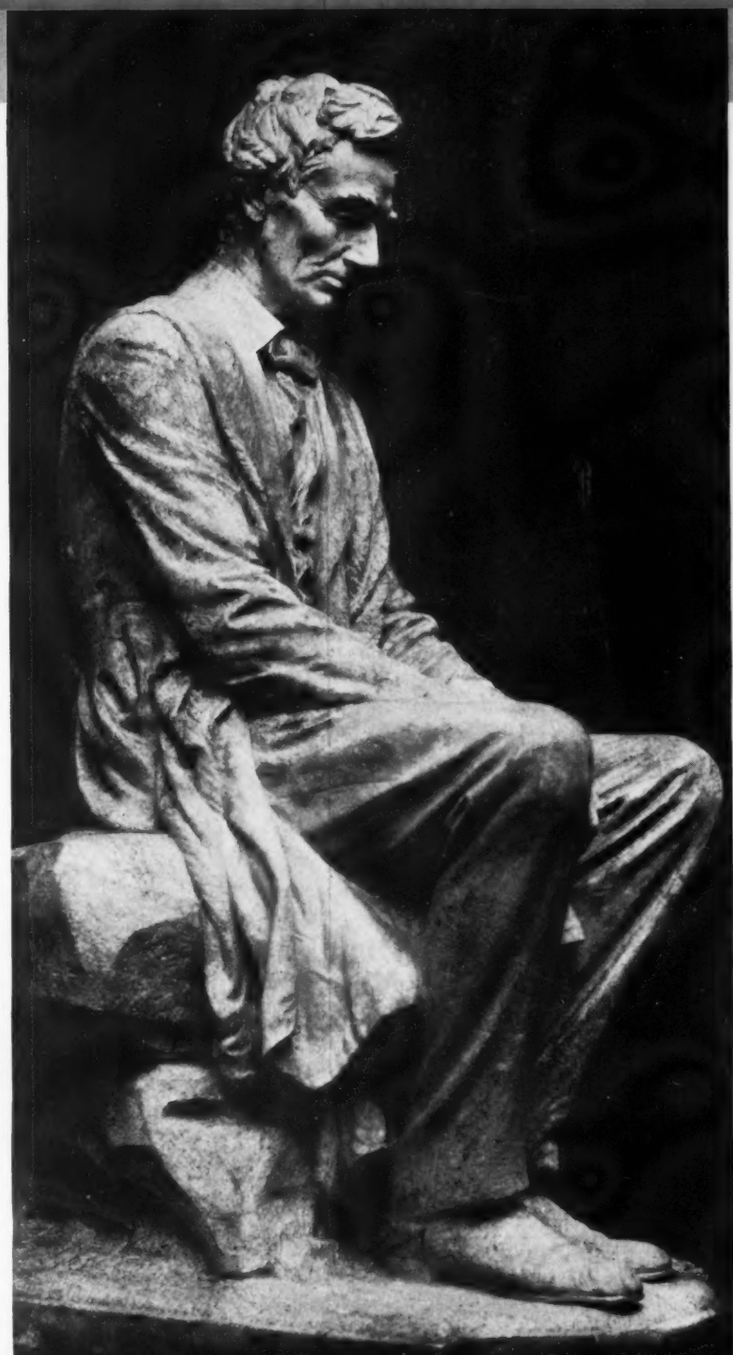
FEB 1931

ELECTRICAL WORLD

McGraw-Hill Publishing Company, Inc.

FEBRUARY 7, 1931
25 cents per copy



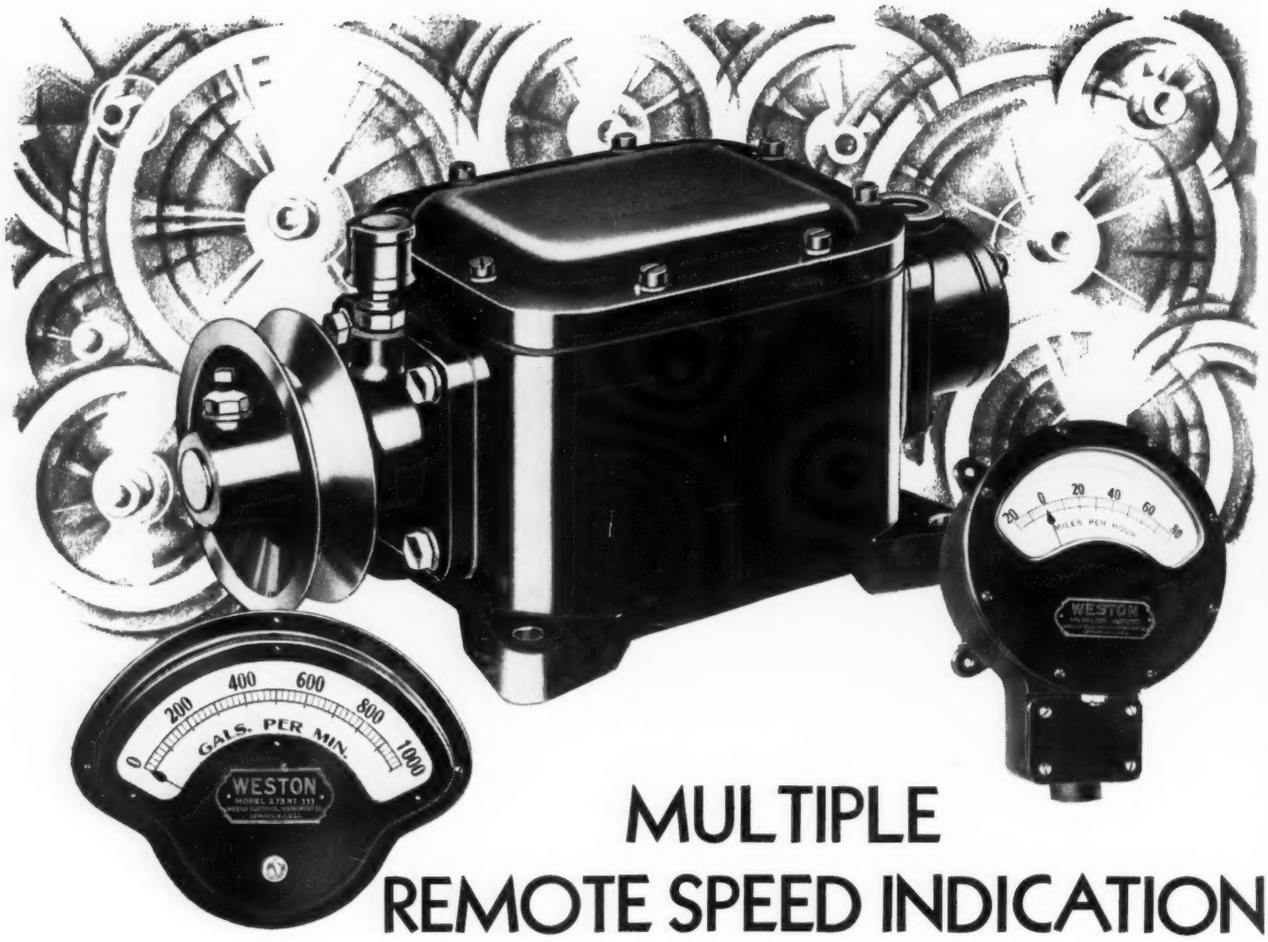
James E. Fraser's statue of Abraham Lincoln which marks the eastern terminus of the Lincoln Highway, at Lincoln Park, New Jersey.

"Stand with anybody that stands right. Stand with him while he is right, and part with him when he goes wrong."

ABRAHAM LINCOLN

...The solidarity of the United States which Abraham Lincoln did so much to preserve, finds yet another expression in the great modern highway running from the Atlantic to the Pacific. It is altogether fitting that it should be named the Lincoln Highway ... and that its eastern terminus, at Lincoln Park, New Jersey, should be marked by this (James E. Fraser's) Statue of Lincoln.

SANGAMO ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS



MULTIPLE REMOTE SPEED INDICATION

with Weston Electric Tachometers

IN many industries, dependable, accurate knowledge of the speed of rotating devices is needed for efficient operation. With the Weston Electric Tachometers, the speed indicator may be placed immediately before the operator of the machine at the point of control. Whether this is near the rotating part or thousands of feet away, the reading will be equally accurate and reliable.

Weston Electric Tachometers not only permit *remote* speed indication but *multiple* remote speed indication. Two, three or any desired number of indicators, at different locations, may be used with the one instrument. These features of the Weston Electric Tachometer, plus its ability to quickly, smoothly indicate speed fluctuations, its long life and freedom from maintenance, has made it the recognized standard equipment in the railway, marine, aviation, bus and industrial fields.

Weston Electric Tachometers consist of a small magneto which is driven by the rotating device whose speed is to be measured. The magneto generates a voltage directly proportional to the driven speed. This voltage is carried by cables to indicating instruments located wherever they can be the most useful. The indicating instruments are Weston Voltmeters with scales calibrated in R.P.M.'s or any other desired unit.

Weston Tachometers are made as Model 44 for heavy duty work and Model 544 for use where an SAE Tachometer outlet is available. Model 44 is made in several types for different applications.

The Weston Laboratories will be glad to lend their cooperation in developing new or special applications of Tachometers.

WESTON ELECTRICAL INSTRUMENT CORPORATION
578 Frelinghuysen Avenue **Newark, N. J.**

ELECTRICAL WORLD

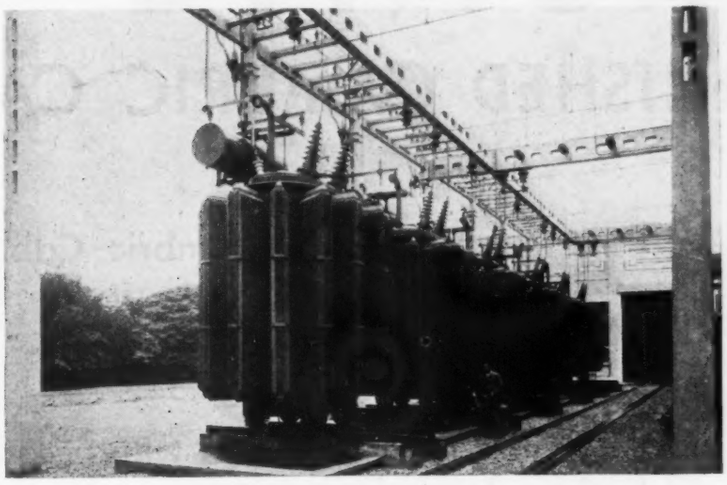
A consolidation of Electrical World, Electrical Engineer and American Electrician

ALLEN M. PERRY
Managing Editor
EARL WHITEHORNE
Contributing Editor
G. F. WITTIG
Statistical Editor
H. M. CAMERON
Associate Editor
A. E. KNOWLTON
Associate Editor
F. C. WELLS
News Editor
E. R. SEARLES
Assistant Editor

L. W. W. MORROW, *Editor*

FRANK R. INNES
Western Editor
520 N. Michigan Ave.
Chicago
H. S. KNOWLTON
New England Editor
1427 Statler Bldg.,
Boston
WALTER C. HESTON
Pacific Coast Editor
883 Mission St.
San Francisco
PAUL WOOTON
Washington
Correspondent
National Press Bldg.
Washington

JAMES H. RUDD
Publishing Director



60-kv. Conflans substation, Paris, France

FEBRUARY 7, 1931

Contents Copyrighted, 1931, by McGraw-Hill Publishing Company, Inc.

VOLUME 97 . . . NUMBER 6

News of the Industry 257

A. I. E. E. Convention Marks Technical Progress 268

Lightning—the enigma 269
Rectifiers for railroad electrification improved 271
Protective devices strike fire 272
Inductive co-ordination yields to ten years of effort 275
Welding made easier 276
Research on commutation, oil and impregnated paper 277
Industrial engineers have special session 279
Telegraphy speeds up 281

Institute President Assails Politics in Business 284

By W. S. LEE, *President American Institute of Electrical Engineers*

Enter a New Domestic Circuit Breaker 287

By FRANK THORNTON, JR., *Westinghouse Electric & Manufacturing Company*

Need Proper Adjustment of Market Price to Cost 290

By CLARENCE L. COLLENS, *President National Electrical Manufacturers' Association*

McGRAW-HILL PUBLISHING COMPANY, INC., Tenth Ave. at 36th St., New York, N. Y.

JAMES H. MCGRAW, Chairman of the Board
MALCOLM MUIR, President
JAMES H. MCGRAW, JR., Vice-Pres. and Treas.
EDWARD J. MEHREN, Vice-President
MASON BRITTON, Vice-President
EDGAR KOBAK, Vice-President
HAROLD W. MCGRAW, Vice-President
H. C. PARMELEE, Editorial Director
C. H. THOMPSON, Secretary

CABLE ADDRESS: *"Machinist, N. Y."*

Published weekly. $5 per year. 25 cents per copy. Entered as second-class matter, January 30, 1907, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Printed in U. S. A.

Member A.B.C.
Member A.B.P.

NUMBER OF COPIES PRINTED THIS ISSUE, 18,330

NEW YORK District Office, 285 Madison Avenue
WASHINGTON, National Press Building
CHICAGO, 520 N. Michigan Avenue
PHILADELPHIA, 1600 Arch Street
CLEVELAND, 501 Guardian Building
ST. LOUIS, 1556 Bell Telephone Building
SAN FRANCISCO, 883 Mission Street
BOSTON, 1427 Statler Building
GREENVILLE, S. C., 1301 Woodside Building
DETROIT, 2-257 General Motors Building
LOS ANGELES, 632 Chamber of Commerce Bldg.
LONDON, 6 Bouverie Street, London, E. C. 4

OKONITE

VARNISHED CAMBRIC CABLES

OKONITE Varnished Cambric Cables, like Okonite Rubber Cables, are of the finest quality with a perfect performance record back of them.

Wires and cables insulated with Okonite varnished cambric, of every type and application, have been used for many years in all parts of electric power plants: generating stations, switching stations, sub-stations, and for underground, submarine, and aerial power cables.

Quality means performance with varnished cambric cables just as much as with other insulation. We, therefore, give the most scrupulous attention to the selection of materials and to every detail in the manufacture of these cables in order that their reliability is assured.

Inquiries are solicited and our engineering service is always available.

OKONITE PRODUCTS

Okonite Insulated Wires and Cables

Varnished Cambric Cables

Okonite Insulating Tape

Manson & Dundee Friction Tapes

Okocord

Okoloom

OKONITE-CALLENDER PRODUCTS

Impregnated Paper Cables

Super-tension Cables

Splicing Materials

THE OKONITE COMPANY

Founded 1878

THE OKONITE-CALLENDER CABLE COMPANY, INC.

Factories: Passaic, N. J. Paterson, N. J.

SALES OFFICES:

NEW YORK CHICAGO PITTSBURGH ST. LOUIS BOSTON ATLANTA

BIRMINGHAM SAN FRANCISCO LOS ANGELES SEATTLE DALLAS

Novelty Electric Co., Philadelphia, Pa
F. D. Lawrence Electric Co., Cincinnati, O.

Canadian Representatives:
Engineering Materials, Limited, Montreal

Cuban Representatives:
Victor G. Mendoza Co., Havana

OKONITE QUALITY CANNOT BE WRITTEN INTO A SPECIFICATION

ELECTRICAL WORLD

for the Week Ending

February 7, 1931

Prosperity cannot return if utility credit is destroyed and the development of utility properties is held back. If here and there abuses of sound policies of public welfare have taken place, let these be dealt with individually. But let us not destroy the industry to punish the few.

MELVIN A. TRAYLOR,
President
First National Bank of Chicago

Clarion River company loses suit over pre-license costs

Further technical progress reported at A. I. E. E. convention

—**Utility properties written up** from $99,500 to $9,975,000 by Alabama Power Company, it is charged. T. W. Martin says value of vision, courage and financing ability of men who came with properties made it an equitable transaction—*p. 261.*

—**Pinchot appeals to A.I.E.E.** for facts regarding distribution costs. Following President Lee's stirring appeal, Pennsylvania Governor offers something specific for engineers to volunteer information about—*p. 258.*

—**To force rail electrification** of every service within 50 miles of city terminals is object of Chicago *Tribune* suit against 24 carriers. A clean-up for the World's Fair on an ambitious scale—*p. 260.*

—**Pre-license-costs suit is lost** by Clarion River Power Company in decision of Supreme Court of District of Columbia. Other projects on which decisions pend are involved—*p. 257.*

—**Buffalo works on changeover** from 25- to 60-cycle system. In 220 days 41,500 customers have been shifted. Revamping of entire distribution facilities to be involved ultimately—*p. 261.*

—**A.I.E.E. convention sessions** reported in detail. Technical progress continues, with engineers' resourcefulness showing new ways to accomplish better results more economically—*p. 268-283.*

—**Cumberland Falls released** by Insulls as prospective power site, thus terminating long fight over Kentucky hydro plans. Site to be a public preserve under du Pont financing—*p. 260.*

—**Plan now for future business** urges Clarence L. Collens. Head of N.E.M.A. would have manufacturers look to modernization, stability, adequate statistics and profit margins—*p. 290.*

Clarion River Power Company Loses Suit Against Federal Commission

RIGHT of the Federal Power Commission to audit the capital expenditures of the hydro-electric projects licensed under the water-power act was upheld in a sweeping decision handed down on January 29 by Justice Jesse C. Adkins of the District of Columbia Supreme Court.

Denying the temporary injunction sought by the Clarion River Power Company of Pennsylvania, a subsidiary of the Associated Gas & Electric Company, the court sustained the commission's contention that it had the authority to require the company to omit from its accounts cost items not held by the commission to be "actual legitimate expenditures."

The suit was brought after the chief accountant of the commission had eliminated in his preliminary audits $6,387,000 from the Clarion's listed capital expenditures of $11,032,000. Contending that the water-power act provided for such showing only after the expiration of the 50-year license, or 20 years at the earliest, the company went into court.

Judge Adkins, who remarked that probably the correct figure of cost in the Clarion River case was somewhere between the amount set by the company and that set by the commission, said among other things in his finding:

It is clear that water power is to be developed by private capital, but that excessive profits are to be prevented either by regulation of rates or a recapture of a portion of the profits either by the states in which they are situated or by the United States and the application of the excess profits to the reduction of the net investment in property. Finally, at the end of fifty years, the United States has the privilege of taking over the project at the then net investment.

It is apparent that it is of the utmost importance both to the owner and to the United States that the actual legitimate cost of the original project should be known to all parties promptly upon the completion of the project.

I am of the opinion that it was the intention of Congress to give the commission power to make this determination upon the completion of the project, and from year to year thereafter; that such power is necessary to the administration of the statute; that such power was conferred by the statute, and that the exercise of that power has been provided for by the rules and regulations adopted by the commission under the statute and by the conditions inserted in the license which the plaintiff accepted and under which it is operating.

This case was unconnected with the application for a license on New River, Va., in which Attorney-General Mitchell held that the jurisdiction of the Federal Power Commission over a non-navigable branch of a navigable stream extends only to the matter of maintaining navigability on the main river. An appeal in the Clarion River case is thought likely.

▼

Pinchot Seeks Data on Distribution Costs

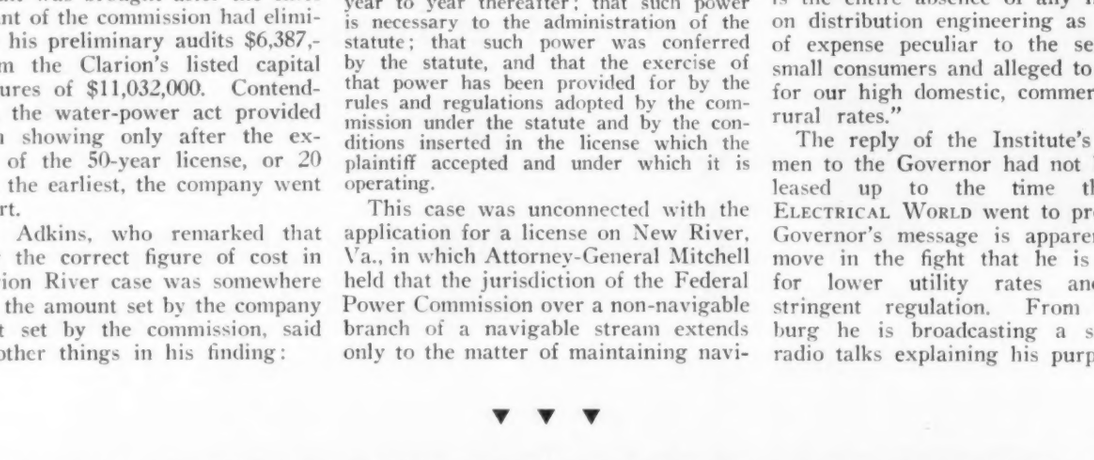
IN A MESSAGE sent by Governor Pinchot of Pennsylvania to President Lee of the American Institute of Electrical Engineers during the latter part of the convention of that body in New York last week the Governor called attention to the lack of generally available data on the cost of distributing energy to the ultimate conumer.

"It is most unfortunate," said the Governor among other things, "that this vast field of engineering and social outlay remains uncovered by an appropriate literature. One of the principal difficulties in regulating domestic, commercial and rural electric service is the entire absence of any literature on distribution engineering as a phase of expense peculiar to the service to small consumers and alleged to account for our high domestic, commercial and rural rates."

The reply of the Institute's spokesmen to the Governor had not been released up to the time that the ELECTRICAL WORLD went to press. The Governor's message is apparently one move in the fight that he is making for lower utility rates and more stringent regulation. From Harrisburg he is broadcasting a series of radio talks explaining his purposes.

▼ ▼ ▼

EDISON ACHIEVES EIGHTY-FOURTH BIRTHDAY NEXT WEDNESDAY



—Wide World Photos —Internat. News Reel

Mr. Edison will this year again spend his birthday in Florida. On the right he is shown at Newark waiting with his wife for the train to Fort Myers, whither he departed two or three weeks ago. On the left is a reproduction of a bronze plaque of the inventor unveiled a few days previously in the new Hotel Edison, New York City.

Rock Island Project Said to Infringe 1846 Treaty

A TEMPORARY RESTRAINING ORDER stopping certain work on the Rock Island hydro-electric project of the Puget Sound Power & Light Company, setting February 13 as date for hearing, was issued Tuesday by the Washington State Supreme Court, on appeal of the Landrett Lumber Company of Wenatchee, which claims that the Columbia River at this point is navigable and that a treaty between the United States and Great Britain, ratified in 1846, pledges that the river will be kept open from its source to the Pacific Ocean. President A. W. Leonard of the company says the restraining order pertains to the west channel of the river, where only preliminary surveys have been made, and will have no immediate effect on construction.

▼

Insulls Buy Maryland, Delaware and Virginia Plants

ALL THE PROPERTIES and holdings of the Empire Public Service Corporation in Maryland and Delaware and certain properties in Virginia have been purchased from the F. W. Woodcock interests of Philadelphia for cash by the National Public Service Corporation, an Insull holding company. The properties, which have assets estimated at $4,000,000, are the Maryland Light & Power Company, the East Coast Utilities Company's Delaware plants and a portion of the latter company's holdings in Virginia, near Cape Charles.

▼

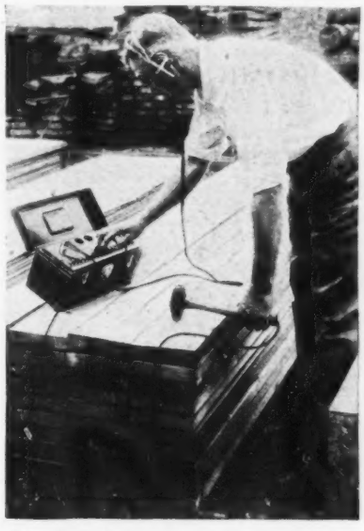
Senate Fights Only Smith as Power Commissioner

FOLLOWING THE REPORTING OUT to the Senate by its interstate commerce committee, without comment, of the names of George Otis Smith, Marcel Garsaud and Claude L. Draper—confirmation of whose selection as members of the Federal Power Commission many senators sought to rescind after originally extending it, as told in late issues of the ELECTRICAL WORLD—the Upper House again voted on their indorsement on Wednesday, with the result that Mr. Garsaud was reconfirmed by 39 to 35, Mr. Draper by 39 to 36, and Chairman Smith rejected by 40 to 33, the majority being made up of Democrats and radical Republicans. Senator Walsh of Montana then altered his resolution to order the institution of legal proceedings to test the right of the three commissioners to their office so that it now applies to Mr. Smith only. This resolution had not been passed as the ELECTRICAL WORLD went to press, but its adoption seemed to be indicated.

Chairman Smith made this comment: "It is very satisfactory to me to have the Senate focus the recall issue. The interests of economy and efficiency will be served by having only one of the commissioners under fire. This improves the load factor of the Federal Power Commission."

▼

MEASURING MOISTURE



An electrical instrument developed at the forest products laboratory of the United States Department of Agriculture determines instantaneously the approximate degree of moisture in any piece of wood, the wood acting as resistor and the number of flashes in a unit of time giving the answer.

▼

Los Angeles G. & E. Wins Franchise Suit in Part

DECISION WAS RENDERED by the Los Angeles County Superior Court on January 29 in the franchise suit instituted by the city of Los Angeles in 1927 against the Los Angeles Gas & Electric Corporation, sustaining the right of the corporation to use the streets for the distribution of electricity for power purposes by means of its facilities and equipment as they existed on August 9, 1927, the date of the filing of the complaint.

The suit was brought against the corporation on the theory that it did not have the right to use the city streets for electric power distribution without a city franchise. Such a franchise had been acquired by one of the corporation's predecessors in 1891, but it had expired in 1916. The corporation's defense was that the state constitution as it existed prior to its amendment in 1911 gave it the rights which were denied by the city, and further that the city was estopped to question the corporation's rights by having acquiesced in and encouraged its operations and expansions, thereby leading the corporation to expend about $33,000,000.

The court also ordered that the corporation shall not be enjoined from extending its facilities and equipment where the electrical energy to be distributed thereby shall be used for "illuminating light," even though the same equipment may also convey energy which, after it has passed through the purchaser's meter, may be used for either power or heat, or both, in addition to "illuminating light." A condition was added, however, that the major use by the purchaser shall be that of illuminating light and the use of energy for heat or power shall be only incidental.

The effect of the decision is to assure in perpetuity the corporation's status as of the date of the filing of the suit, but to forbid it from hereafter extending its distribution lines in the city streets for the purpose of serving electricity for power purposes only. Both the city and the corporation are expected to appeal to the State Supreme Court.

▼

Carlisle and Roosevelt Radiate Friendliness

THE NIAGARA-HUDSON POWER CORPORATION will agree to generation of power on the St. Lawrence River by the state and will be willing to make a contract calling for a 7 per cent return on its distribution investment, compared with the 8 per cent allowed utility companies by the courts, Floyd L. Carlisle, chairman of the board of the corporation, said at a dinner of the Albany Chamber of Commerce on February 2. His statement was the first announcement by the company of its attitude on the report of the St. Lawrence Power Development Commission.

Governor Roosevelt, also a speaker at the dinner, agreed with Mr. Carlisle that the "differences are not great" between them. In the Governor's reference to the power situation he said: "I hope very much that we shall, and see no reason why we shall not, be able to agree on the methods for this development." "Floyd and I," the Governor added, referring to Mr. Carlisle as an old friend, "are both experts on the same line. We are 100 per cent in favor of greatly extending the use of electricity."

Utility Relinquishes Cumberland Falls Site

CONTENTION OVER Cumberland Falls, Ky., where for six years the Insull interests have sought to build a hydro-electric plant against the opposition of scenery preservationists in and out of Kentucky but with the support of many prominent citizens of the state, including Governor Flem D. Sampson, has come to an end through the state's purchase for $400,000 of the site owned by the Insulls. This carries out the action of the Legislature last year in accepting an offer of $230,000 from former United States Senator T. Coleman du Pont with which to buy the property and convert it into a state park. Mr. du Pont has died since the Legislature adjourned.

Two appraisers fixed the value of the property at $1,186,000, a third member of the board insisting that $190,000 would be enough. Mr. du Pont's heirs raised his donation to $400,000, and this the Cumberland River Power Company, the Insull organization, accepted, although it is asserted that it is actually a little less than the company paid for the property plus its subsequent legal expense in the effort to get state and federal approval. A license had never been issued by the Federal Power Commission, which, however, held many hearings on the proposal and obtained from Attorney-General Mitchell an unfavorable interpretation of its right to heed esthetic considerations in dealing with non-navigable reaches of navigable streams.

▼

Midwest Power and Engineering Conference

ON THE OPENING DAY of the fifth Midwest power and engineering conference, to be held at Chicago February 10 to 15, a power economics session under the chairmanship of C. F. Hirshfeld of Detroit will hear papers by well-known engineers on balancing plant investment with operating cost, advance in electrical distribution and commercial distribution of high-pressure steam.

Wednesday morning's session also will be of special interest to electrical engineers because of the presentation of papers on trends in steam-turbine development, reciprocating engines for the higher pressures and water turbines of propeller type. A. H. Bailey of Chicago will preside. R. F. Schuchardt, chairman of the afternoon session, will discuss requirements for the pumping of oil, gas and gasoline, and other papers will cover electric welding in the power plant and high-voltage direct-current transmission. Other sessions will be on fuel conservation, prime movers and water problems of the power plant.

The power exposition, held simultaneously with the conference, will demonstrate among other things how to reduce plant operating costs, the application of new methods to old plants and the betterment of production by the use of steam and electricity.

The power exposition, held simul- which binds together chemistry, physics, electricity, radio, biology and astronomy will be discussed by O. H. Caldwell, editor of *Electronics* and former Federal Radio Commissioner, at the banquet session on Thursday evening. Illustrations of novel electronic applications will be shown.

▼

CHROMIUM DISTILLED IN ELECTRIC FURNACE

Director G. K. Burgess, Bureau of Standards, examines the first specimen of distilled chromium, in the hand of Director L. W. Chubb, Westinghouse Research Laboratories. It was distilled in a vacuum of 0.0001 mm. at about 4,200 deg. F.

▼

Chicago Tribune Would Force Electrification

TWENTY-FOUR RAILROAD COMPANIES are defendants in a complaint by the Tribune Company of Chicago which the Illinois Commerce Commission now has under advisement. The newspaper company is trying to compel the railroads to electrify their service within 50 miles of the Chicago terminals and to modernize their stations by reconstruction and enlargement.

The complaint states that "the passenger train service performed by the said defendants . . . into and out of their respective passenger terminal stations in Chicago (with the sole exception of the Illinois Central Railroad Company's suburban traffic, between Randolph Street station and Matteson) is performed by steam locomotives"; that all equipment is solely designed for steam motive power, and that the equipment, appliances, facilities and service (except those of the Illinois Central suburban service) are "unsafe, improper, inadequate and insufficient." The Chicago & Northwestern Railway, Grand Central, La Salle Street, Dearborn and Central stations are all branded as "archaic and wholly inadequate to meet the modern needs for terminals." The Union Station alone is described as being of "modern construction and well operated." The complaint cites the need of augmented service before the World's Fair of 1933.

▼

Hydro Projects Go Ahead on Texas Colorado River

CONTRACT FOR CONSTRUCTION of a six-million-dollar dam and electric power plant near Burnet, on the Colorado River of Texas, was to be awarded about this time by the Emery, Peck & Rockwood Development Company of Chicago, F. A. Dale, Texas manager of that company, said recently, and construction will start promptly. About two and one-half years will be required to complete the project, and the Texas Hydro-Electric Company will take over and operate the plant when it is completed. Five other similar dams and power plants, Mr. Dale says, will be constructed by the company at points on the Colorado River between Kingsland and Austin. It has already spent approximately $1,250,000 in preliminary work.

The Burnet dam will be 9,000 ft. long, have a maximum height of 137 ft. and be 225 ft. thick at its base. The plant will have a capacity of 30,000 hp. The dam will create a lake about 7 miles wide and approximately 50 miles long, covering more than 25,000 acres. This reservoir will store 1,150,000 acre-feet of water as a year-around power supply for the five other dams below.

The Emery, Peck & Rockwood Development Company in the last five years has constructed three dams and hydro-electric plants on the Guadalupe River of Texas and now has under construction two similar projects on that stream. All of this electric power, as well as that which is to be developed

on the Colorado River, has been contracted for by power companies operating trunk transmission lines in Texas, Mr. Dale says.

▼

Buffalo Utility Changes Customers' Equipment

FORTY PER CENT of the customers of the Buffalo General Electric Company, or 41,500 of them, had their equipment changed over last year from 25 cycles to 60 cycles in 220 working days. This change is still under way. When the 60-cycle system is complete it will carry a total load of 125,000 kw.

The change included adjustment of all 25-cycle appliances and reconstruction of 35,000 25-cycle meters. Simultaneously the company installed an 80,000-kw., 60-cycle generator, built two 110-kv. transmission circuits, opened 143,860 ft. of trenches, laid 31½ miles of conduit and about 1,000,000 ft. of underground cables, completed and put in use eight substations, five more being ready for service and six under way, and put 31 small transformer stations under sidewalks to supply low-voltage alternating current in the downtown business section.

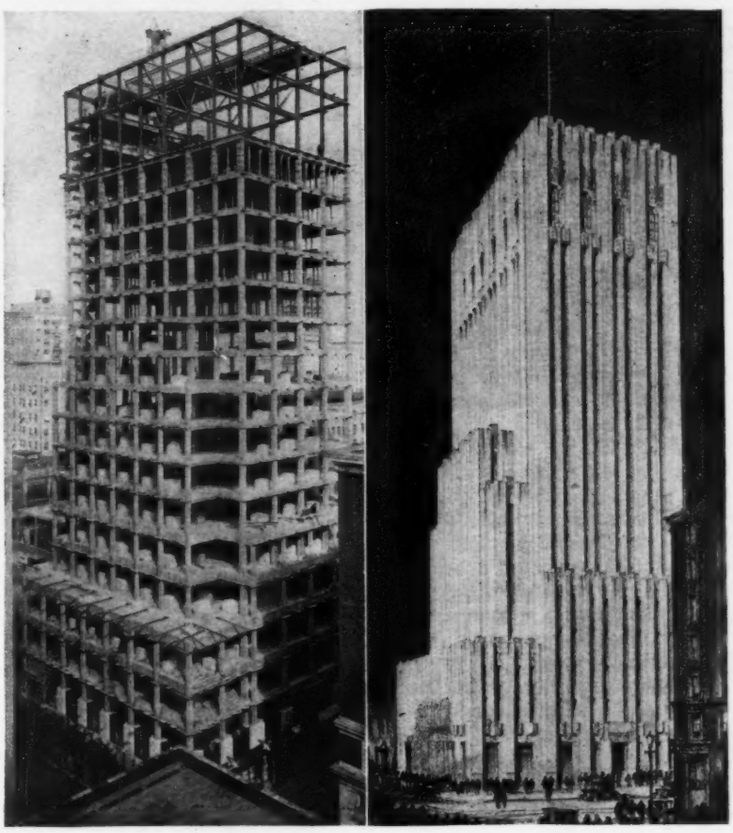
▼

Calls "Men of Vision" Alabama Power's Asset

HEARINGS ON THURSDAY and Friday of last week by the Federal Trade Commission into the affairs of the Alabama Power Company were followed by an adjournment until February 5. Continuing his testimony, R. J. Ryder, a commission accountant, went into the company's connection with Wilson Dam and United States Nitrate Plant No. 2, described its rate structure, asserted its return on property investment to have varied from 5.28 per cent in 1920 to 6.51 per cent in 1923 and 6.36 per cent in 1929, said that since 1925 $81,955 had been paid in management fees to the Southwestern Power & Light Company and $270,034 to the Southeastern Engineering Company, and bore testimony that "all customers of the Alabama Power Company of the same class pay the same rates throughout the state, regardless of whether or not they are located near a hydro-electric generating plant."

President Thomas W. Martin went into the history of the company and paid tribute to the "men with vision and courage" who had gone ahead with development and raised the necessary capital. In reply to a question, he called these men an "asset" that accrued to the company in 1913 at the time when mergers led to additional stock issues of approximately $10,000,000.

DALLAS HAS HIGHEST ARC-WELDED STRUCTURE



Nineteen stories in height, with a floor area of 140,000 sq.ft., indirect illumination throughout and every modern facility for public service, the arc-welded steel and concrete office building of the Dallas Power & Light Company has reached the stage shown on the left. On the right is the architect's drawing.

▼ ▼ ▼

Power and Regulation in State Legislatures

ARKANSAS.—A House bill proposes to levy a tax on the consumption of electrical energy as follows: 1 cent per kilowatt-hour up to 100 kw-hr. inclusive, 0.5 cent from 101 to 1,000 kw.-hr., 0.25 cent from 1,001 to 10,000 kw.-hr., and 0.1 cent for all in excess. Proceeds would be applied to the payment of school district indebtedness.

CONNECTICUT. — Four bills affecting utility regulation have been introduced in the Senate, the result of a conference between Democratic legislative leaders and Yale professors. One bill requires utility companies to give the Public Utilities Commission complete schedules of rates and charges, with 20 days' notice to the public through the press and the commission of proposed changes. Another provides that stock or bonds can be issued only on approval of the commission. A third gives the commission authority to initiate rate hearings concerning charges of public service companies. The fourth bill amends the law concerning the filing of reports.

GEORGIA. — Representative Kennedy, father of the measure to impose a tax of 2 mills on every kilowatt-hour of hydro-electric energy produced in the state, amended the bill, following a hearing, to make the tax 0.5 mill, as in Alabama. None the less, the committee on ways and means reported unfavorably on the bill by 24 to 18.

ILLINOIS.—In line with the Chicago *Tribune's* campaign for electrification in Chicago, noted elsewhere in this issue, a House bill introduced by Representative Gaines provides that no railroad operating in a city with a population of a million or more shall after January 1, 1935, use any motive power except electricity. The Commerce Commission, after a public hearing, would be authorized, however, upon sufficient reason, to extend the time limit for not more than five additional years.

INDIANA.—A public hearing on the Moorhead bill to declare any investment

company controlling more than 30 per cent of the common stock of an Indiana utility a public utility in itself, subject to commission regulation, was held on January 30. Doubt of the constitutionality of the bill was expressed, and a divided committee report, with a majority for indefinite postponement, was prophesied. Bankers oppose the measure strongly. The House has rejected by 59 to 29 a unanimous adverse report of the judiciary committee on the Kistler bill (No. 112, described last week, page 217) and sent it to second reading.

NEW YORK.—Governor Roosevelt, after conferring with the St. Lawrence Power Development Commission, announced that the commissioners would prepare a bill, to be introduced in a few weeks, to provide for carrying the St. Lawrence project forward to the construction stage. Under the provisions of a bill introduced independently in the Senate by a Republican and in the Assembly by a Democrat a section is added to the public service law providing that submetering companies shall not charge tenants more than the rate of the electric company, shall pay interest on deposits on meters or for energy and shall provide facilities for inspection of meters. This measure was introduced last year as part of the report of the special commission which investigated the public service law, but failed of passage.

OKLAHOMA.—A Senate bill provides that municipalities when granting a franchise to a public utility shall specify in the franchise the rates to be observed by the public utility during its term and that the Corporation Commission shall have no authority to change these rates except upon the application or with the expressed consent of the mayor and city council or the governing body of such municipality.

OREGON.—Three bills giving concrete expression to the power program of Governor Julius L. Meier of Oregon have been introduced. The so-called "public utilities bill" would change the organization and duties of the Public Service Commission; the "water conservation act" revises the law under which water appropriations can be made, and the "district power bill" is designed to make effective the constitutional amendment adopted in the November election. (ELECTRICAL WORLD, January 24, page 174). The district power bill permits the formation of districts comprising contiguous or non-contiguous territory or one or more municipalities. Districts would be managed by five elected directors. Governor Meier has surprised many by advocating taxation of municipal utilities. He explains that by so doing their opponents would be deprived of the tax argument.

ELECTRICITY PIERCES DENSE CHICAGO FOG

—Underwood & Underwood

Chicago has its fogs too, like London and New York. A particularly dense one recently enhanced rather than detracted from this night view of a central section.

▼ ▼ ▼

PENNSYLVANIA.—A broad-scope resolution appropriating $100,000 for an investigation of the Public Service Commission, moved by Representative D. G. Moore, passed the House on Tuesday by 121 to 70—a victory for Governor Pinchot. The committee of inquiry would consist of three senators, three representatives and three outsiders appointed by the Governor. Senator Salus' resolution for investigation by a senatorial committee of six Republicans and three Democrats and the first resolution introduced by Senator Earnest, both referred to last week, are likely to be superseded in the Senate by a second Earnest resolution intrusting the investigation to the Senate's judiciary general committee through a subcommittee of nine, a report to be made by March 10. The Moore resolution was thought likely to be defeated in the Upper House. The Earnest motion would not need the concurrence of the Lower House as it makes no appropriation.

WASHINGTON.—An organized attack, headed by Mayor Frank Edwards of Seattle, will be made against the proposal to subject public utilities to a state tax of 5 per cent on their gross revenues, as proposed in a measure pending in the Legislature. Opposition will also be turned against a resolution to submit to the voters a proposal to amend the state constitution so that the various counties may levy property taxes against public utility holdings within their borders. Under the proposed amendment Seattle would be subjected to taxation by several outside counties because of its development on the Skagit River and its transmission lines through Skagit and Snohomish Counties. Tacoma city officials will join with Seattle.

WEST VIRGINIA.—Imposition of a privilege or gross sales tax on the production of electric power is included in a bill introduced in the House. The tax upon electric light and power companies would be increased from 0.6 per cent to 2 per cent. For the development of power in the state a tax of 6 per cent would be exacted. Many major changes in the Public Service Commission law are proposed in the Hodges-Watson bill, now before both houses. The royalty on power developed would be increased from 10 cents an annual horsepower to $2. Developments would be confined to a single site instead of an entire watershed. An independent survey of the hydro resources of the state by the Public Service Commission is provided for. Ten years would be the maximum period for developing projects. Radical changes in the recapture clauses and in the phraseology elsewhere in the bill are made.

WISCONSIN.—A reduction of 10 per cent in all electric light, power, gas and telephone rates, as an emergency measure effective for six months, is demanded in a joint resolution that was sent to committee. The Loomis measures referred to last week and several other bills with more or less bearing on utility companies were also in committee when this was written.

Scattered Happenings in the Electrical Sphere

United States

ALLEGING THAT RATES for electrical energy collected by the San Joaquin Light & Power Corporation in Merced, Mariposa and five other counties are unjust, the California Farm Bureau Federation has filed a complaint with the California Railroad Commission asking it to conduct an investigation.

A SESSION UNDER the auspices of the American Welding Society and two others under the auspices of the A.I.E.E. and the Pacific Coast Electrical Association will form part of the Western Metal Congress to be held at San Francisco on February 16 to 20. A. F. Davis of the Lincoln Electric Company will discuss structural arc welding on February 18 and G. E. Stolz and George W. Bernhard applications of electricity to steel on February 20.

A MOTION IN THE HEARINGS on rates of the Union Electric Light & Power Company of St. Louis that an appraisal be ordered before any reduction is made was overruled by the commission last week.

C. ERNEST GREENWOOD, commercial director N.E.L.A.; B. W. Cowperthwait, president North Central Division of that body; J. W. Lapham, secretary, and a number of other speakers addressed a "bury depression" session of the commercial branch of the divisional body named at Minneapolis last week.

INSTALLATION OF CITY-OWNED generating equipment for Granite Falls, Minn., was favored at a recent election. Only one councilman favorable to the present contract with the Northern States Power Company was elected.

WISCONSIN'S SUPREME COURT has ruled that the city of Plymouth may not take action against the Wisconsin Gas & Electric Company for extending its electric lines into the town of Plymouth, denying the city's claim of exclusive rights and sustaining the utility's action under indeterminate permit.

THE ILLINOIS COMMERCE COMMISSION will not require a public utility to restore service to a consumer whose electric meter had been removed when the company alleged the consumer was guilty of stealing electricity, though the charge was denied. An order just issued by the commission holds that the complaining consumer must seek his remedy in a court.

ATTORNEY-GENERAL SORENSEN of Nebraska advocates a state trade commission to prevent "unfair tactics" by public utilities in the sale of electric and gas appliances. These are frequently sold at a loss, he said, and the loss made up out of rates.

ARGUMENTS IN THE SUIT of Alabama vs. the United States, by which the state is trying to collect from the federal government a tax on the manufacture and sale of power at Muscle Shoals, were heard by the United States Supreme Court on January 29, the Solicitor-General of the United States again insisting that the case should be dismissed and the Attorney-General of Alabama asserting that when the nation "invades the field of private enterprise it subjects itself to the incidents of that business, including any tax which the state may lawfully impose."

LITIGATION OVER non-development of water power at Beebe's Island, N. Y., put at 10,000 hp., will soon come before the New York Supreme Court, Knowlton Brothers being the plaintiffs and the Beebe Island Corporation the defendant. Negotiations to have the Niagara-Hudson Power Corporation take over the rights have not yet borne fruit. Another New York water-power suit of long standing—that of the Horton family against the Niagara-Hudson Power Corporation for water rights on the Salmon River—has been decided by the New York Supreme Court in favor of the power company in two cases, a third case being remanded to commissioners for rehearing.

THE SUPREME COURT OF ERRORS at New Haven has upheld the Attorney-General against Albert Levitt, Redding, Conn., in the former's appeal from the refusal of the Superior Court to grant a rehearing of mandamus proceedings instituted by Mr. Levitt, and the case has been remanded. (ELECTRICAL WORLD, December 27, 1930, page 1161.)

THE REDLAND IRRIGATION COMPANY of Grand Junction, Colo., which has a small hydro-electric plant with a capacity of 1,200 hp., has a plan to install equipment to increase the rating perhaps to 21,000 hp. Its excess output is sold to the Public Service Company of Colorado.

KERCKHOFF HALL, a new eight-hundred-thousand-dollar University Union building presented to the University of California at Los Angeles as a memorial to the late William G. Kerckhoff, pioneer in hydro-electric development in California, was dedicated January 20. Mr. Kerckhoff died two years ago.

Canada

THE INTERNATIONAL HYDRO-ELECTRIC SYSTEM, a division of the International Paper & Power Company, has ordered a seventh 34,000-hp. unit for installation in its Paugan generating station on the Gatineau River, Quebec.

IN A RECENT REVIEW of the Ontario Hydro's present water-power resources F. A. Gaby, chief engineer of the commission, issued a warning that Ontario industry would be checked by serious power shortage in four or five years if no additional provisions for power are made immediately. Development of power on the St. Lawrence cannot be relied upon as an immediate remedy, he said, because "if St. Lawrence power international treaty arrangements were to commence tomorrow, power would not be available for nine or ten years."

Abroad

CAMBRIDGE UNIVERSITY will celebrate on October 1 and 2 the centenary of the birth of James Clerk Maxwell, eminent physicist, electrotechnological pioneer and founder of the school of experimental physics in Cambridge.

DIRECTORS OF THE SOUTHERN RAILWAY, one of the four main-line groups in the United Kingdom, have authorized electrification extensions from London to Reigate, Brighton and West Worthing, involving 52 miles of track, at a cost of $13,500,000.

Coming Meetings

Midwest Power Engineering Conference—Chicago, Feb. 10-13. G. E. Pfisterer, 308 W. Washington St., Chicago.

Public Utility Group, National Association of Purchasing Agents—Statler Hotel, Boston, Feb. 19 and 20. G. A. Renard, 11 Park Place, New York.

North Central Division, N.E.L.A.—Engineering meeting, Minneapolis, Feb. 23 and 24. J. W. Lapham, 803 Plymouth Bldg., Minneapolis.

Electrical Advertising Conference—Westinghouse Lighting Institute, New York, Feb. 25-27. E. A. Mills, New York Edison Co., New York.

American Institute of Electrical Engineers—District meeting, Pittsburgh, March 9-13. F. L. Hutchinson, 33 W. 39th St., New York.

Oklahoma Utilities Association—Oklahoma City, March 10-12. E. F. McKay, 1020 Petroleum Bldg., Oklahoma City.

Illinois State Electric Association—Springfield, Ill., March 12 and 13. G. W. Schwaner, 205 Illinois Mine Workers' Bldg., Springfield, Ill.

Northwest Electric Light and Power Association—Commercial Section, Spokane, Wash., March 16-18; Engineering Section, Wenatchee, Wash., March 18-20; Accounting Section, Salt Lake City, April 13 and 14. B. Snow, 1208 Spalding Bldg., Portland, Ore.

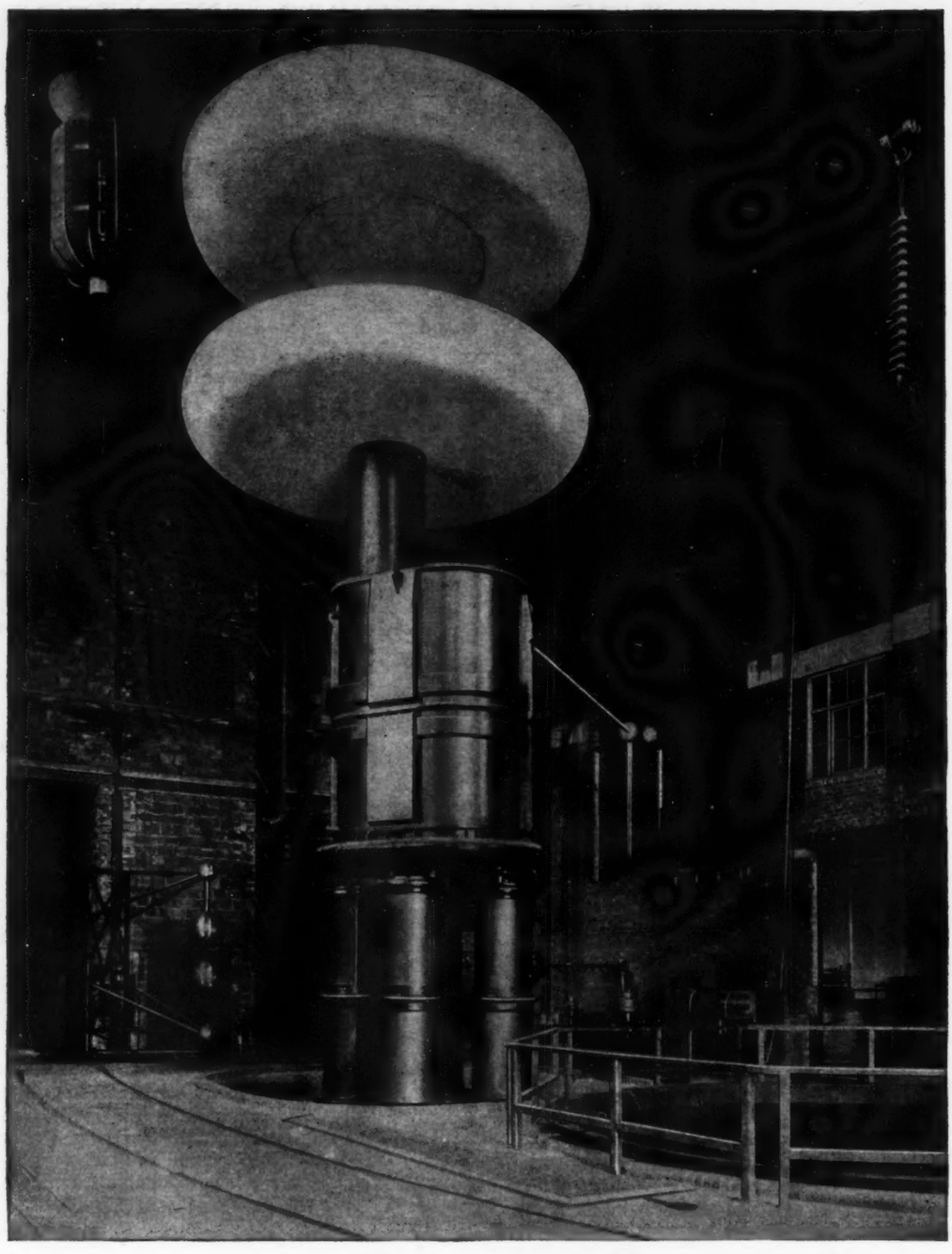
Southeastern Division, N.E.L.A.—Vinoy Park Hotel, St. Petersburg, Fla., April 1-3. C. M. Kilian, 508 Haas-Howell Bldg., Atlanta, Ga.

Maryland Utilities Association—Lord Baltimore Hotel, Baltimore, April 10. D. E. Kinnear, 803 Court Square Bldg., Baltimore.

Missouri Association of Public Utilities—Excelsior Springs, Mo., April 16-18. F. D. Beardslee, 315 N. 12th St., St. Louis.

Southwestern Geographic Division, N.E.L.A.—Mineral Wells, Tex., April 21-24. S. J. Ballinger, San Antonio Public Service Co., San Antonio, Tex.

Electrochemical Society—Hotel Tutwiler, Birmingham, Ala., April 23-25. C. G. Fink, Columbia University, New York.



England, Too, Has High-Voltage Tests

Facts on which to base design and determine performance are eagerly sought wherever electrical engineers are active. This huge condenser has been installed at the recently completed research laboratory of Metropolitan-Vickers at Manchester, England.

EDITORIALS

L.W.W.MORROW
Editor

Convention emphasizes professional obligations

ENGINEERS in convention assembled have a right to expect a program comprehensive in its coverage of the areas embraced by their composite professional activity. The gathering of the A.I.E.E. in New York last week must have left little to lament about omissions. The sessions opened with an unusually vigorous address by the president, and in the technical sessions which followed the most active phases of the electrical art were surveyed and projected. Administrators, supervisors, operatives, theorists and designers all had their innings.

Committee meetings in parallel with convention sessions were encouraged after a period of ban. They added a considerable stimulus to the discussion of trends and pressing problems, not only within the committee meetings and on the convention floor, but also in the impromptu gatherings in lobby and corridor from which fruitful results so often originate. Entirely apart from the enlarged attendance (despite business depression), part of which may be attributed to the promoted presence of committee members, the satisfactory results obtained should confirm the re-established practice. There remain to be found more effective means of informing engineers, in and out of the Institute, of the programs on which committees are engaged. A wider knowledge of these programs would help materially in fortifying interest in the society as a whole and undoubtedly induce voluntary contributions to the solution of the problems in hand.

President Lee in his opening address impressed upon the engineering profession its duty to organized society in connection with governmental activities, so many of which are tangent to the field of the engineer. If politics and engineering will not mix in intimate solution, then it behooves the engineer to correlate engineering with economics and submerge the purely political factors by supplying the clarity which will dissolve all precipitate political expediencies. Muscle Shoals was his principal example, and no more vigorous portrayal of the fallacies that have led to this great national fiasco has ever been made. It is plainly the duty of engineers and economists to join hands and steer the ship of state away from such muddy waters of mixed demagogism and science.

Another subject of high professional significance was the broad interpretation of the inductive co-ordination of power and telephone systems. This falls almost entirely within the electrical province, and so does the subject matter on research, protective devices, machinery, lightning and telegraphy. Other sessions dealt with matters of interest to industries in which electrical knowledge is a distinctly useful adjunct—transportation, welding, industrial power usage. On the whole, the program struck most of the notes in the themes in which electrical engineers are and should be concerned in this particular day and age.

Securities already offered exceed third of 1931 budget

JANUARY'S financing gives at least a preliminary answer to the question, "Can the power companies secure their 1931 budget needs of $900,000,000 under present or prospective market conditions?" The month's offerings of over $381,000,000 amounts to about 42 per cent of this total. Of course, these securities are not yet all in the hands of the ultimate investor, and they

are not all for new construction—probably half will be used for refunding. Yet the apparent ability of the market to absorb or at least to receive this enormous total without being unduly weakened is highly significant of what can be done as the market gradually strengthens. Apart from budget requirements, this year's financing must take care of a larger than average refunding program as well as certain projected mergers.

The terms under which the capital is being obtained are very favorable. January's bond financing was on a 4.59 per cent basis against an average of 4.92 per cent for January of last year and an average of 4.97 per cent for the entire year 1930.

Mortgage-bond financing accounted for more than $225,000,000 of the January total. Most of this is of 30 years' duration or more, insuring the borrowers against tighter money conditions for some years to come. The balance is made up of common-stock rights to a total of $80,000,000, a few short-term issues and one preferred-stock issue of $25,000,000.

It may be assumed from the behavior of the bond market last month that a stable market can be sustained if reasonable discretion is used in placing new issues, especially as the stock market becomes gradually stronger.

Oil-breaker theory

NEITHER the deïonization principle nor the liquid-dielectric principle can account entirely for the interruption of an arc in oil. It is a complex phenomenon and calls for a combining of several principles. This may be shown by high-speed photographs of actual arcs in oil.

As the electrodes separate, the intense heat of a short, dense arc disintegrates and starts to volatilize adjacent oil, forcing the formation of a turbulent gaseous bubble of oil-decomposition products of irregular shape about the current path and causing turbulence in adjacent oil. This action continues as the electrodes continue to separate, the increasing amount of decomposition products causing an appreciable and enlarging pear-shaped bubble to be made that contains gaseous products of oil decomposition. In this medium the current flows. The extent and shape of the bubble depend upon the characteristics of the oil, the energy in the arc, the pressure and temperature conditions, the mechanical arrangements of the arc chamber and its physical contents. The bubble at this stage is a luminous body of gas with no clearly defined columnar arc in it. It is a gas arc of variable luminosity with variable current density in any cross-section surrounded by turbulent oil under pressure. A further stage is soon reached as the electrodes separate where the arc during a current cycle is struck from the moving electrode directly in the oil to the gas bubble. This stage depends upon several factors, including temperature, the rate of gas formation, rate of gaseous deïonization and electrode speed of separation. The arc strikes from the moving electrode directly through the oil for a short distance and thence through the conducting gas bubble to the other electrode. This complex arc is accompanied by variable temperature, pressure and density. It has variable rates of deïonization and variable degrees of physical turbulence in the oil. It also is affected by the electric charge effects on oil particles both as regards mutual attraction and repulsion and the attraction and repulsion between electrodes.

At a still later stage, when the current is small, the combined effects produce a more intimate mixture of oil globules in the gas mixture to cause the bubble to break up into a turbulent arc path of mixed oil and gas. This would lower temperatures, increase deïonization and cause a higher dielectric barrier to be interposed in the arc path. Soon after this the arc will not be re-established because of the electrode separation and an increased dielectric strength in the arc path.

Thus the phenomenon of arc interruption in oil is not a simple matter. It embodies the deïonization theory, the effects of solid oil in spray and globules, the pressure and temperature conditions, the mechanical arrangements, the oil characteristics and the energy dealt with. No one theory or principle will explain the action. But an engineering attempt to use all factors to best advantage to interrupt the arc quickly and safely is a very feasible project. That this has been done quite intelligently is attested by the performance of oil breakers of very different mechanical design characteristics. Nor has the complete application of the knowledge learned been made. The industry may expect still better breakers in future.

Regulation versus contracts

TO REGULATION another vote of lost confidence is accorded in the message of New York's Governor to the Legislature on the matter of power from the St. Lawrence. Circumstances "have made impossible the fulfillment of the original purposes of regulation." The message advocates with vigor the establishment of a power authority to administer the St. Lawrence development and the sale of its product. It is apparently hoped that a contractual basis for this sale will circumvent the legal protractions that have in some instances delayed the results of the regulatory procedure. But the power authority, like the Public Service Commission, would be a creature of the Legislature, derive limited powers from it, be amenable to its discipline and be subject to court review of acts of omission and commission. It is a bit hard to see how the reputed weakness of the Governor's hand-picked regulatory body can be replaced by strength in a comparable body under another designation.

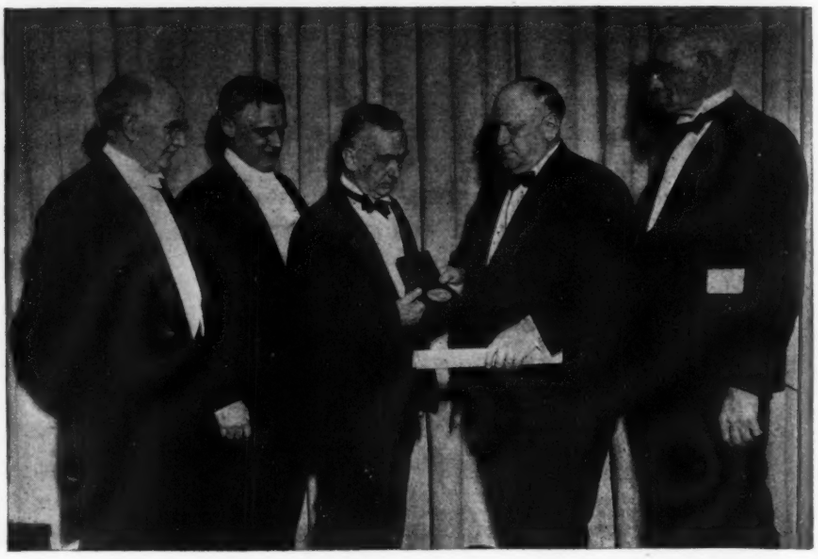
The element of weakness in the "authority" proposal is that the same board which will supervise the operation of state-owned generation facilities will dictate the terms under which its output will reach the ultimate user. That board becomes at once judge, jury, prosecutor and defendant. It will be strange if this effort to supplant an existing tribunal of review does not create new constitutional difficulties in the end by consolidating functions that work best in a democracy when segregated.

Incidentally the Governor's notion is that the "fair price to the consumer" should "make allowances only for a fair return to the companies on the actual capital invested in the transmitting and distributing of this particular power energy." This raises the interesting question of differentiating the state's production from that originating in the steam or hydro units of the Niagara-Hudson and other companies, the two supplies being scrambled in delivery to the consumers. In the cases where steam and hydro power already available can produce a kilowatt-hour cheaper than the proposed St. Lawrence plant utilities would be faced with the anomalous situation of charging the customer more for the New York State authority's power than for that coming over the same wires from privately owned plants. It is doubtful whether this eventuality was fully grasped as a potential political bomerang.

Luminous-tube progress rapid

RARE-GAS tubes are now applicable to commercial, industrial and special residential lighting at 110 volts and 220 volts. By advances in electrode design and in the mixing of gases a greatly increased range of color effects has been achieved, including the production of artificial daylight illumination on a large scale. Notable gains have also been attained in intensities of illumination, the new units reaching values as high as 2,000 lumens per foot. But it is possible to look directly at the tubes for several minutes and turn immediately to read fine print without undue eye strain. The rise in temperature of the new tubes is greatly reduced and the colors are derived directly from the gaseous source of illumination. Less than 20 per cent of the energy is required to produce blue or green light compared with filtered incandescent lighting, about 33 per cent of the energy for red and about 50 per cent of the energy for white. These lights are now said to operate at 80 per cent power factors.

The increased efficiency attained by these units is expected to lead to the use of much higher intensities in practice, and the absence of glare and the uniformity of distribution realized combine to make this type of lighting attractive to the industry. The life of the units is given as 3,000 hours minimum. On the economic side, the first cost of application may for the present be about double that of filament lighting. It is anticipated that the availability of these units for ordinary interior lighting-circuit voltages will bring about revolutionary changes in the design of fittings and that flush type and concealed mountings will become widely utilized. Other possibilities include decorative lighting with dial or other graduated control through electron tubes. These new lighting units of daylight quality and of high color value promise many commercial and technical changes in the art of illumination. They represent progress, but they must be assimilated gradually.



Dr. Frank Conrad (center) awarded Edison Medal. Others are D. C. Jackson, K. T. Compton, W. S. Lee and C. F. Scott.

A.I.E.E. Convention Marks Technical Progress

EACH year the midwinter convention of the American Institute of Electrical Engineers focuses attention upon new electrical developments and upon the place of engineers in industry progress. Last week more than 1,500 electrical engineers met in New York at their professional convention. They established new standards of proficiency in the art, honored one of their associates for meritorious achievement and discussed their common problems in a friendly environment. This convention was notable for three outstanding reasons:

1. President W. S. Lee called upon engineers to face courageously the political problems of the nation and demanded that they fight for what they believed to be the best interests of the country in the political arena. He denounced government ownership as a false beacon of political leaders and said the engineers were primarily responsible for guiding the body politic in matters of national policy that dealt with engineering and economic business enterprises.

2. At no convention in recent years were there more notable technical papers presented. Positive steps in progress were recorded.

In the realm of circuit breakers new equipment was announced, field tests substantiated performance claims of existing types and new theories of arc interruption in oil were stated.

In the broad field of lightning and lightning protection much new data were presented as to the character and effects of lightning, field data on lightning were increased and several new or improved protective arrangements and devices were announced.

In miscellaneous branches of the art, such as telegraphy, single-phase commutator motors, inductive co-ordination, electrical machinery, railway electrification, electric welding, industrial power applications and research, splendid papers

surveyed the present status of engineering and gave details of new equipments and practices.

The technical program was unusually meritorious and responsive to current conditions and seemed to indicate that business depression acts as a spur to technical advances.

3. The last but not least aspect of the meeting was the honor paid Dr. Frank Conrad, Edison medalist, for his meritorious achievements in the art. This notable event, featured by addresses of leading engineers, showed that engineers have human qualities of kindly feeling and appreciation of personal accomplishment whereby recognition and honor are given where these are deserved. Real and lasting values are associated with the tribute paid to Dr. Conrad.

Add to these distinctive features the many committee meetings, the inspection trips, the smoker, the dinner dance and the rounded program of work and pleasure may be visualized. This past midwinter meeting was a very necessary and valuable convention that contributed still more to the already enviable record of electrical engineers.

▼ ▼ ▼

Lightning—the enigma

Outages continue erratically.
Operating men debate effects.
Can the problem be solved?
Direct strokes unconquered.

ELECTRICAL engineers, it would appear, still have a great deal to learn about lightning. Once, not so long ago, it seemed so amenable to solution. Today doubts still arise. Meanwhile outages continue. There is a vast wealth of knowledge comprising tabulated facts of dates, circumstances, locations and havoc wrought by the mysterious bolts from the blue, and gray, but how definitely to lightning-proof a line is still a largely unsolved problem. The ultimate question is really, Can overhead lines be made immune? There was a rather definite air of uncertainty about this session of the American Institute of Electrical Engineers' winter convention. The usually colorful discussion of basic facts was toned down to carefully thought-out statements.

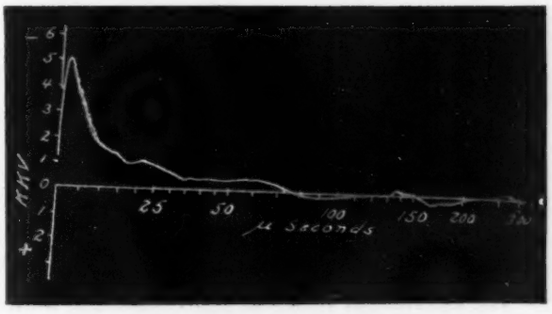
Tackling the uncomfortably unknown from the mathematical angle, L. V. Bewley of General Electric offered a masterly development of the theory of traveling waves on multi-conductor systems together with a compendium on the general subject of traveling waves on transmission systems. Every element constituting induced and direct strokes corresponding to various laws of cloud discharge was reduced to the several possible basic elements and recombined to offer curves and formulas corresponding to the compounding of these sample waves to produce complex waves. A graphical lattice for computing successive wave reflections was welcomed by several speakers as an outstanding contribution to the useful working tools of the lightning investigator. Mr. Bewley also discussed the effect of line losses in equalizing the subsidence of traveling waves and upon their attenuation and distortions.

The question of just how much may be really known about actual wave forms unless these are measured at the point of origin is the complicating element which arises in correlating such mathematical studies in theory with oscillographic records obtained in the field. An experimental evaluation is plainly needed. Other engineers in discussing this presentation pointed to the discrepancies between observed and derived curves.

An endeavor to separate the individual waves from oscillographic field records of the voltage at a transition point, due to the superposition of several successive reflections, has been made by J. C. Dowell of the General Electric Company, the essential idea being to determine the attenuation of the waves on the transmission line. Use of the lattices mentioned previously is said to have offered a convenient means of keeping track of successive reflections.

Here again was the investigation closely allied with the theory. It must have been with no little regret that Mr. Dowell concluded: "This investigation cannot be regarded as accurate and definite. But the study was of value in demonstrating the limitations of trying to calculate attenuation from the measurements of successive reflections—limitations in both the mathematical work and the oscillograph circuit. The behavior of artificial lightning surges over a transmission line may be computed with a reasonable degree of engineering accuracy by treating the line as distortionless.

So far so good, but how is the practical application



5,000,000-volt lightning surge recorded; oscillogram retouched
(Pittman-Torok)

of more or less abstract studies to the problem of making lines free from lightning and surge interruptions working out? As reported on page 227 of the January 31, 1931, issue of ELECTRICAL WORLD, Philip Sporn offered tangible and precise data regarding the 1929 experiences of the American Gas & Electric Company on its 132-kv. system. For five years Mr. Sporn has reported to the A.I.E.E. upon the work of his organization in operating

its lines in a peculiarly lightning-full territory. This year he offered evidence of both greatly increased lightning storm frequency and consequent increased outages, the increases being related in the respective percentages of 141 and 158. Considerable analysis to link the effects of lower footing resistance and lightning flashover was made, and around this centered much of the discussion, particularly with regard to the effectiveness of ground wires and upper conductors of a configuration in protecting the lower ones from induced flashovers.

Attempts to relate the footing resistances of towers struck with resistances at adjacent towers, to develop any theory of selective failures at any one of the group, were hotly attacked by L. V. Bewley, who maintained that such attempts were in error, since the tower struck and the point of flashover was solely a matter of the distances involved when ground footing resistances did not exceed the 20-30 ohms found here. J. J. Torok maintained that in one instance at least outages to the number of thirteen on Mr. Sporn's system could have been reduced to not more than two had the shielding effect of two ground wires instead of one, as used, been taken advantage of.

On the basis of his 1929 experiences Mr. Sporn concluded that:

On two-circuit lines the likelihood of both circuits tripping out is comparatively small—only 16 to 29.5 per cent of the trip-outs involving both circuits.

The only line equipped with two ground wires had 3.6 outages per 100 miles of line per year, while the only line without a ground wire had 76.

A line with one ground wire in 1929 had 37.4 outages per 100 miles of line per year and in 1928, with no ground wire and on a basis of adjusted storm frequency, 59.3 outages.

Grading shields had little effect.

Wood pole transmission lines are regaining a certain favor for their inherent high-insulating qualities and tests upon a 110-kv., 28-mile section of the system of the Arkansas Power & Light Company were made by R. R. Pittman and J. J. Torok of that utility and Westinghouse Electric & Manufacturing Company, respectively. Here is was found that:

1. The frequent flashovers of crossarms and poles accompanied by circuit breaker operations indicate that insulating a line is not a solution to the lightning problems.
2. Voltages of high magnitudes may be transmitted for several miles along high-insulated transmission lines to terminal apparatus.
3. The experimental results of this investigation show that voltages of a harmful character to high-voltage lines appear only when direct strokes or their branches terminate on the conductors.
4. The fronts of surges at their points of origin may have a rate of rise of 4,000 kv. or more per miscrosecond.
5. Trip-outs on ungrounded wood-pole construction of the type described in this paper are usually the result of phase-to-phase flashovers.
6. In this investigation lightning currents of more than 25,000 amp. are indicated.
7. Transients appearing on transmission lines can be limited to values within the strengths of terminal equipment by the use of suitable protective devices.
8. Limited field investigations indicate that an arrester of the expulsion form will successfully function to interrupt dynamic current follow-up.

Other companies have been experimenting similarly, and E. C. Williams of the Public Service Company of Northern Illinois told of 90 miles of wood-pole lines installed by his organization in the past two years. According to Mr. Williams, the results were most encouraging and in his opinion wood-pole construction remains the only alternative to more costly underground lines for voltages up to 50 kv. It was stated by him that 9 ft. of wood between conductors on 40-ft. poles is sufficient to prevent 60-cycle follow-up after high-voltage and impulse flashovers.

In order to determine the most effective point for installation of lightning arresters in substations a study was recently made by the Public Service Electric & Gas Company (New Jersey) and Westinghouse engineers. An analysis of the effects of various amounts of connected bus and station apparatus was also made covering a 220-kv. switching substation surged through 8 miles of line and a 26-kv. distribution substation surged through 5 miles of overhead line and 2 miles of cable:

1. The capacity to ground of the bus and circuit breakers in large substations tends to reduce the terminal voltage. In general, the effect of connecting the transformer to the bus system is further to slope off the front and reduce the crest. The total effect is more pronounced in the case of very short waves, but appears appreciable for those of moderate length.
2. When lightning arresters are placed on the bus, the voltage at the transformer will be greater than that at the arrester by an amount depending upon the steepness of the lightning transient, the arrester voltage, and the circuit distance from the arrester to the transformer. The seriousness of such overvoltages decreases with increasing arrester voltage rating for any given arrester location.
3. The data indicate that the attenuation in cable of surges of the voltages used in these tests is of relatively small magnitude.
4. In small substations fed by cables the capacity of the bus and connected apparatus causes a relatively small decrease in the terminal voltage. This effect is slight because of the lesser terminal capacity and the low surge impedance of the entering feeders.
5. In small substations no appreciable difference in surge wave shape is found at various points within the station.
6. A large measure of protection is afforded substations by a number of connected high-voltage cables.
7. In the case of a lightning arrester placed on a line joining a long cable leading to a substation, the station protection is increased as the arrester is moved away from the junction along the open wire.
8. High ground resistance is found to decrease materially the protective value of line arresters. In the case of very high resistance grounds arrester performance can be improved by running a connection from the high-resistance ground to the cable sheath.

H. C. Don Carlos of the Hydro-Electric Power Commission of Ontario concurred with the advocates of wood-pole construction, citing instances of comparative performance records in successive years which such a line built through rocky country where without a ground wire frequent difficulties due to lightning occurred, but subsequent to the installation of such protection outages or flashovers which were due to that cause no longer took place.

In summing up his acceptances on the subject F. W. Peek, Jr., of the General Electric Company urged low towers, ground wires and points of grounding of low resistance, stating that whether troubles be due to induced or direct strokes, these are most important elements. In the case of direct strokes Mr. Peek felt low ground resistance to be especially important. For induced strokes a moderately low figure was assumed to suffice. The critical value was placed by him at about 30 ohms, check-

ing with Mr. Sporn's finding for 1929. Above that figure direct strokes become, in Mr. Peek's judgment, causes of definite outages.

The crux of the lightning situation as it now stands seems to center around two points: (1) Induced strokes may be, and have to some degree been, conquered, but direct strokes remain as a far-from-defeated foe; (2) can the splendid progress made in decreasing flashovers be carried to the ultimate goal of virtual elimination with any possible type of protective devices and arrangements, or is there a limit beyond which inherent limitations prevent passage? It may be that a wholly different idea, eliminating both the extremely susceptible overhead lines and present designs of prohibitively costly underground ones, will displace these, with their manifest and manifold shortcomings, if the lightning problem is ever to be truly solved.

Almost the final word in this question, at least so far as present acceptances is concerned, was voiced by H. L. Melvin of the Electric Bond & Share Company. "No practical amount of insulation," said Mr. Melvin, "is possible for protection against direct strokes."

Research reports to the subcommittee on towers and conductors, which met during the convention, reveal many continuing difficulties in the determination of causes of conductor vibration and of the embrittlement of steel. Hope exists that some progress toward the solution of such problems will be realized through the co-ordination of inquiries, the pooling of experience and, in particular, through reduction in the number of variables involved.

▼ ▼ ▼

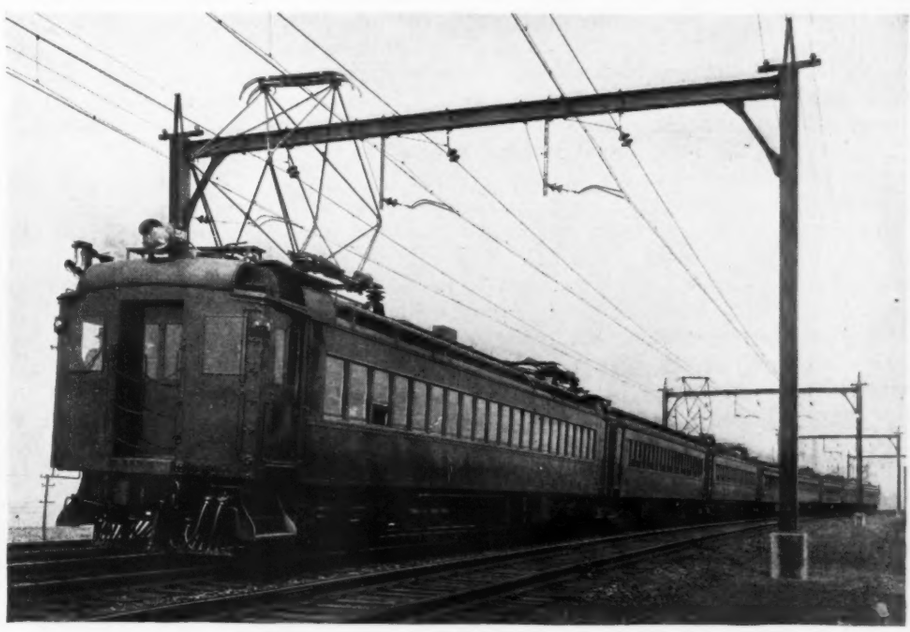
Rectifiers for railroad electrification improved

Mercury-arc equipment meets heavy-duty service effectively. Five hundred per cent overload handled on Lackawanna test.

RECTIFIERS of the mercury-arc type rated at 3,000 kw. and delivering direct current at 3,000 volts to the Lackawanna Railroad trains in the New York suburban electrification carried six times their rating for fifteen seconds in a recent test, according to a paper by E. L. Moreland of Jackson & Moreland at the transportation session, presided over by Sidney Withington of the New Haven system. The Lackawanna is the first important railroad electrification which depends entirely on mercury-arc rectifiers for direct-current energy supply from substations distributing purchased power for heavy traction service. Mr. Moreland presented a thoroughgoing description of this installation, which receives energy from three power companies on separate contracts. In general, the equipment is rendering an excellent account of itself, and while some trouble is still being experienced from arc-backs in the rectifiers, the out-of-service period of a rectifier unit under this condition has been greatly reduced and the prospects are favorable for the ultimate solution of the problem.

The three power companies deliver three-phase, 60-cycle energy at transmission voltages to five substations owned and operated by the railroad. There is no transmission of alternating-current energy along the railroad right-of-way for traction purposes. The power contracts are all of the monthly demand-charge plus energy-charge form. The demand is determined as the average of the three highest clock-hour demands during the month, each month on its own basis, and with provision for the elimination of certain unusual demands caused by unusual conditions and for compensation by the power companies for increased demands on the adjoining companies caused by failure of the power supply.

Splitting up of the power supply among three companies adds materially to the total cost of power, since it deprives the railroad of the benefit of diversity between the demands of the substations on the different power systems. Three contracts were, however, necessary, because the power companies would not offer a single combined proposition, and the cost of an alter-



Suburban electrification with 3,000-volt d.c., Lackawanna Railroad
(Moreland)

nating-current transmission system along the right-of-way, if all requirements could have been secured from a single power company, would have far more than offset the added cost due to loss of diversity between substations.

The substations receiving the purchased energy are much smaller than would have been required to house motor-generator sets. A building inclosing four 3,000-kw. rectifier sets is only 64 ft. long x 40 ft. wide x 27 ft. high, inside. The rectifiers were bought under specifications for satisfactory operation for two hours at 50 per cent overload and 200 per cent overload for five minutes. The efficiencies run from 5 to 10 per cent higher than motor-generators at practically all loads, and are even better at one-quarter rating. Compounding was provided to insure improved distribution of load between adjacent substations. The tendency to arc back is considerably reduced by the use of special anode grid shielding.

In the discussion it was brought out that to date no complaints as to impairment of radio reception have been charged to the railroad, and that the use of smoothing reactors and resonant shunts on the direct-current side of the system has protected communication circuits against interference. It may be necessary to take measures to prevent harmonics from interfering on the alternating-current side of the system, through co-operative co-ordination.

The power factor of the compounded rectifier unit, including the transformer, is 96.5 per cent lagging at 25 per cent load and 99 per cent lagging at 300 per cent load.

Charles H. Lydell cited the value of high-speed circuit breakers in protecting feeders from substations to contact wires against lightning disturbances in railroad electrification in South Africa.

Noteworthy progress in the calculation of catenary suspensions was featured in other papers and discussions at this session. An important advance in the detection of rail flaws by means of an inductive pick-up apparatus utilizing vacuum tube amplification was described by H. C. Drake. The equipment is designed for service on a railroad car and promises to be of much value in the detection of fissures and other faults often hidden from visual inspection.

▼ ▼ ▼

Protective devices strike fire

Arc extinction theories hotly debated.
Equipment performance continues to show further improvement.
Revision of switch standards proposed.

PROSPECTS of a heated discussion arose at the protective devices session when Dr. Joseph Slepian characterized D. C. Prince's and W. F. Skeats' explanation of the theory of the oil-blast circuit breaker as absurd and when he added that the authors had glossed over what happens in the few microseconds before and after arc extinction. Anticipation of fireworks was increased when J. B. MacNeill supplemented Dr. Slepian's comments. But when the assailed authors smilingly replied that, regardless of whose theory is correct, the oil-blast circuit breaker has withstood the most severe field tests of any breaker, the possibilities of an acrimonious argument dwindled and assumed a very friendly basis, although widely divergent views were expressed.

Features of the four circuit breaker papers* at this session were presented in our January 31 issue.

Some discussion occurred on R. C. Bergvall's suggestion of using series resistance to increase transient stability and is briefed later. E. F. W. Beck said that the field tests of "Thyrite" arresters reported by K. B. McEachron and E. J. Wade should give more confidence in calculations, supplementing his remarks by presenting charts showing voltage impressed on transformers in terms of arrester voltage for different wave fronts and distances between transformers and arresters.

In part, Dr. Slepian said:

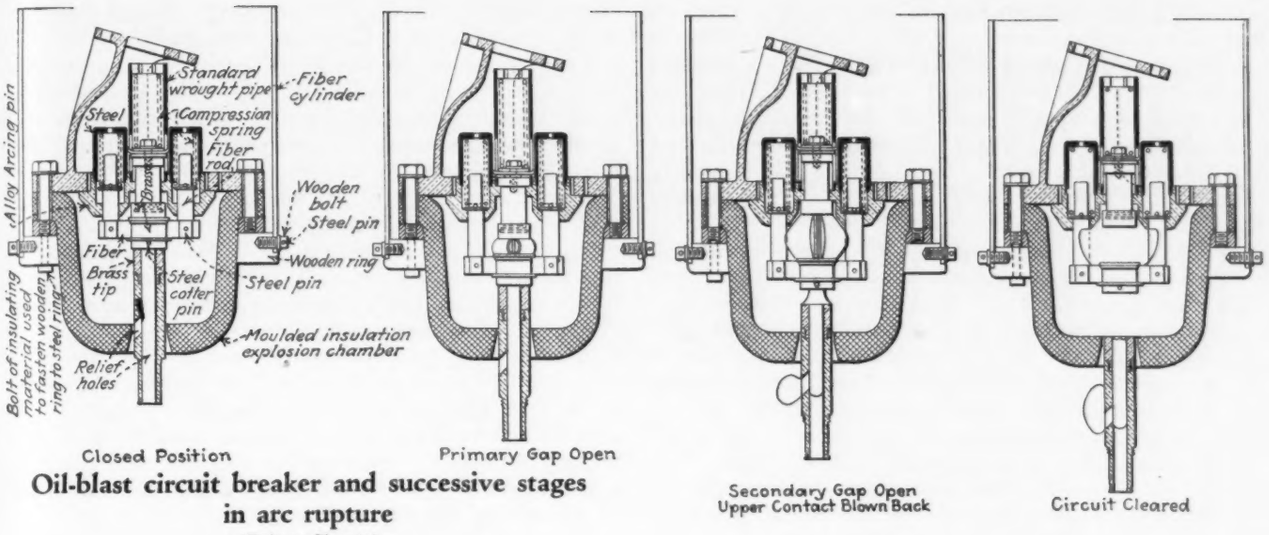
"This paper (Prince and Skeats) presents incorrect conceptions of the nature of the electric arc under oil and uses the kind of loose language in discussing these incorrect conceptions such as has stood in the way of oil circuit breaker development for many years. The great progress in this field which has come in recent years was due first and foremost, apart from the driving force of necessity—that well-known parent of invention—to the clarification and precision of ideas relating to the extinction of alternating-current arcs under oil. If further progress is to be made, these ideas must be still further clarified and made still more precise, even to the point of complete expression in mathematical form. Relapses to the old loose ways of glossing over the happenings in those vital few microseconds after a current zero in which the interruption of the circuit takes place should not be tolerated, and I feel compelled, therefore, in the interest of progress in this art to criticise adversely very many statements made in this paper.

"Everything has been shown except what it is desired to know, namely, how the circuit is interrupted by the interaction of the arc and the oil. The space between the contacts which is highly conducting up until current zero must change over into a good insulator in less than 10 microseconds. It is what is happening in these 10 microseconds which is important in the circuit interruption.

"The authors account for the growing dielectric strength of the arc space after current zero by the formation of a barrier of oil whose growing thickness keeps pace with the growing voltage impressed upon the electrodes by the external circuit. Using the very large figure of 600,000 volts per inch for the dielectric strength of the oil next to the arc, the authors calculate that this barrier of oil must grow in thickness at the rate of 2,500 in. per second to keep pace with the 1.5×10^9 volts per second rate of rise of the voltage impressed upon the electrodes tending to reignite the arc. The authors believe this speed of formation of an oil barrier is attained through the use of the explosion pot.

"But consider the first microsecond of the extinction period. An obstructing film of oil must form across the arc space with a thickness equal to $2{,}500 \times 10^{-6}$ or 0.0025 in., capable of withstanding $1.5 \times 10^9 \times 10^{-6}$ or

*By D. C. Prince and W. F. Skeats, R. M. Spurck and H. E. Strang, Philip Sporn and H. P. St. Clair and J. B. MacNeill.



Oil-blast circuit breaker and successive stages in arc rupture

(Prince-Skeats)

1,500 volts. This film must be completely continuous. Any hole or break in it will cause reignition of the arc. In the next microsecond the film will have grown to 0.005 in. and will be withstanding 3,000 volts, but the film must not waver in its continuity. The slightest hole in it and the arc will reignite. Even more, the film must not waver in its thickness. If it is anywhere less than the required 0.005 in. the arc will reignite.

"What extraordinary hydromechanics will be required which will project such wonderfully continuous and uniform films of oil across the gas space precisely at current zero within a microsecond!

"The absurdity of the theory given here is also revealed at once by the experimental fact that the arc length required to interrupt a circuit was found by the authors to vary with circuit voltage. But if the theory given by the authors was correct, the interruption of the circuit, whether of high or low voltage, would be accomplished by the formation of a barrier of oil growing in thickness at the rate of 2,500 in. per second and withstanding 600 volts per thousandth inch.

"It is not unreasonable to expect the barrier to continue to grow for 100 microseconds, and in this time the oil barrier will have attained a thickness of 0.25 in. and will be capable of withstanding 150,000 volts. Hence, once the rate of voltage rise is about the same for high-voltage circuits as for low, any practical breaker which operates according to the authors' theory, and which is capable of interrupting 15,000 volts, should also be capable of interrupting 150,000 volts.

"The arc in the gas pocket under oil is in a very different state from an arc of like current in a gas volume of like size and pressure but in a chamber whose walls are of non-gas-forming material, such as glass or other refractory. The gas projected from the decomposing oil walls breaks up the structure of the arc continually. The highly ionized conducting paths are swirled around in all parts of the gas bubble. This is the action which is responsible for the interrupting capacity of the oil circuit breaker.

"What, then, is the theory of the explosion pot circuit breaker? An important part is played by the rapid evolution of gas from the oil walls of the gas bubble. In a previous paper I have shown that the action of the gas could be intensified by keeping the oil walls of the bubble close to the arc at all times. In this way the rate of evolution of gas from the oil is greatly increased, and the distance through which this gas must move to mix with the arc is greatly reduced. The normal growth of the gas bubble must be combated, as this growth will move the oil walls further from the bulk of the arc.

"By confining the oil in the explosion pot the gas bubble is prevented from attaining the large size it would have if the oil were free to move. Hence, within the explosion pot, there is a more intense rate of gas evolution, a greater volts per inch can be interrupted than with the plain break, in those cases where the interruption takes place with the arc entirely within the pot. This action is still more pronounced for that section of the arc which is in the throat of the chamber. Here the throat walls with the adhering oil press still more closely upon the arc and force the gas bubble section to be small. Furthermore, upon emergence of the electrode, there is at this place an intense blast of gas as the gas stored in the chamber vents itself through the throat as the moving electrode emerges. These are reasons why the likelihood of extinction is greatest at the moment when the electrode emerges from the throat.

"One method of keeping the gas bubble around the arc small is to use a hollow electrode, which will permit venting of the gas from the bubble around the arc and thus reduce its size.

"May it not be that if the intermediary piece (floating contact) were removed, still better results might have been obtained, due to the earlier venting of the gas within the explosion pot through the hollow electrode, giving a smaller bubble around the arc with a reduced pressure within the pot?"

Mr. MacNeill contended that an arc does not form as a cone around an electrode but moves so gas does not necessarily pass through the arc. He also contended that oil-blast breaker tests show a wide range of results (14:1), and that Spurck's paper shows the arc really ruptures outside the explosion chamber, so the Prince theory of arc rupture could not apply. Nevertheless, Mr. MacNeill admitted that the oil-blast breakers had been subjected to the most severe field tests of any breakers.

Philip Sporn reported that his respect for oil breakers had increased since witnessing the test of 1,500,000-kva. oil-blast breakers on a 1,750,000-kva. short circuit in which the circuit was ruptured in less than 7 cycles and the circuit breaker still remained in satisfactory condition for operation. He emphasized that the Philo tests had been conducted partly to determine the feasibility of a multi-duty-cycle rating, and now wants breakers rated at 15-25 shots instead of only two.

W. S. Edsall presented views of a new multi-break oil circuit breaker with looped contacts having horns which extinguish the arc in ½ to 1 cycle. The speed of rupture can be increased by using more turns per loop.

D. C. Prince, one of the authors assailed, as pointed out before, replied to the criticisms in good humor, saying that it doesn't matter whose theory is correct—the oil-blast breaker works anyway. Furthermore, it has withstood more severe tests than any other breaker. He pointed out that tests with and without the floating contact had proved the value of separate pressure-producing and power-extinction arcs. With the theory now available it is possible to calculate the rating of oil-blast breakers definitely from the rate of oil movement. The apparent divergence of results mentioned by Mr. MacNeill, he pointed out, were due to assuming that all tests were reported in the same order.

W. F. Skeats, a co-author, expressed the hope that more confidence would be placed hereafter in tests made under single conditions because the effect of recovery voltage can now be applied to show performance under other conditions.

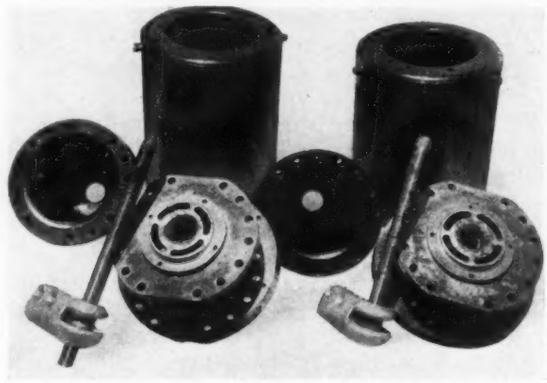
Series resistance for transient stability

Insertion of a series resistance in generator leads when a short circuit occurs was recommended by R. C. Bergvall as a means of increasing transient stability. The series resistance loads the machines during a fault and greatly reduces the normal tendency to overspeed. After the fault has been cleared, the series resistance retards excessive overswing. The author showed that by using series resistance a typical hydro system can maintain synchronism through a three-phase fault with circuit breaker and relay speeds now available. A three-phase resistor normally short circuited by a circuit breaker and connected into the neutral of each generator was recommended as the most desirable arrangement. The author claimed that the cost will generally be much lower than a combination of other measures, such as high-inertia generators, low-reactance generators and transformers, damper windings, transformer neutral impedance, special simultaneous relay schemes and lightning-proof lines. Furthermore, he pointed out, the expenditure can be deferred until it is justified by operating experience.

Discussing Bergvall's suggestion on series resistors for increasing transient stability, John V. Cleary declared that they perform their function at the expense of receiver input and frequency. Curves were presented to show the relative effects of resistors and no resistors. He contended that the value of series braking resistance decreases as higher speed switching is used. Six-cycle switching is fast enough to allow most systems riding through a severe short circuit. The series resistor has less value when higher inertias are considered. Seventy-five per cent of the plants can be handled by other means, such as high-speed switching. Shunt resistors were favored for low-inertia receiver loads.

A rather novel experimental lightning protector for insulators was discussed by J. J. Torok. It consists of a non-conducting small-bore tube with metal electrodes at each end, the separation between the inner ends of the electrodes being about 85 per cent of the outer spacing. With the application of a sufficient potential across the electrodes, the air within the tube breaks down, causing an arc. From that point on the operation is similar to that of an expulsion fuse. The impulse flashover characteristics fall slightly below those for the corresponding needle gap, and are governed more by the spacing of the electrodes than by the internal diameter of the tube. However, the latter greatly affects the interrupting capacity in that with a 1-in. hole only a 500-volt arc can be ruptured, whereas a ⅛-in. hole will rupture an 8,000-volt arc.

Results obtained with "Thyrite" station type arresters of various ratings when subjected to traveling waves on a 45-mile transmission line from a 1,500,000-volt impulse generator were presented by K. B. McEachron and E. J. Wade. The data indicate that the calculated results agree closely with test results for a variety of circuit conditions, so that one may predict with assurance the performance of any arrester of the "Thyrite" type. These arrester tests were made jointly by the Consumers Power Company and the General Electric Company under conditions corresponding to an arrester on each incoming circuit, on a bus between two incoming circuits and on a bus with one incoming and one outgoing circuit.



Oil-blast breaker after thirteen field tests
(Sporn-St. Clair)

Oscillograms made to determine the effect of ground resistance indicated that if the arrester and apparatus grounds are bussed together the potential on the apparatus will be independent of the ground resistance. However, the connections between the grounds should be as short as possible.

Tests on the effect of line flashover on arrester performance indicated that reflections apparently had a period of 8.5 microseconds, which gives a propagation velocity of approximately 800 ft. per microsecond. The original impulse, which had a crest value of about 480 kv. and a wave front of 10 microseconds, reached the open end of the line, where it was reflected, the voltage at the open end being doubled. The reflected voltage wave traveled back toward the impulse generator, adding its potential to that of the original incoming wave.

In studying the protection afforded transmission lines by station arresters, it was found in one case considered that the protection of a 132-kv. arrester does not extend back from the arrester for a distance of more than 500 ft. With a 69-kv. arrester the zone of protection extends somewhat further. For a 0.5 microsecond front no protection is offered at a distance of more than 250 ft. With a one microsecond front this distance is increased to approximately one-half the length of the wave front expressed in feet. When applying transmission line arresters to prevent line flashovers the arresters should be at the point of inception, and to prevent front-of-the-wave flashovers they need to be close together, preferably on each tower.

It was found that the best results can be assured from an arrester if it is connected close to the transformer and if the arrester circuit between the line and the ground is made as short as possible.

Proposes revision of switch standards

Automatic stations have become so important that the A.I.E.E. committee on this subject plans to arrange for an operating experience session at the summer convention in Asheville, N. C., June 22. Papers are contemplated by F. F. Ambuhl, Toronto; Garland Stamper, Columbia Gas & Electric Company, and Philip Sporn, American Gas & Electric Company.

The committee has assumed sponsorship for the study of automatic network protectors and will act as a clearing house of information on this topic. The committee is also investigating fire protection problems in automatic stations as a result of representations by insurance interests, but preliminary inquiries indicate that the fire hazards of these installations are relatively small. Progress is being made in the unification of wiring designs and the co-ordination of practice in sequence functioning.

Closer control of fuses for circuits of more than 750 volts is being considered by the subcommittee on oil circuit breakers, switches and fuses. The committee suggests that papers on the application of high-tension fuses would be desirable in future. At its meeting held during the convention the committee also discussed proposed revisions of standards of disconnecting switches to include knife switches, the relation between duty cycles of breakers as presented in the N.E.M.A. standards, and the insulation of oil circuit breakers.

A tentative agreement has been reached by the relay subcommittee upon a set of standards for vectors and vectorial notation, in an attempt to get rid of the present chaotic situation in this field. Papers are under consideration for future presentation upon the relaying of transmission lines, of various apparatus and on instrument transformer loading and ratio curves.

In co-operation with the electrical apparatus committee of the National Electric Light Association, the subcommittee on lightning arresters is studying the questionnaire prepared by the former organization with the object of bringing out information of value to the designing engineer and manufacturer. The work under way toward arrester standardization is being followed closely by the committee. At present attention will be focused on power circuit arresters, leaving communication and other arrester standardization for future consideration. Interest is active in connection with the standardization of test surges.

Inductive co-ordination yields to ten years of effort

Residual values cause trouble.
Predeterminations difficult.
Grounding values important.
Plan new construction carefully.

THE dominant elements in the telephone problem created by low-frequency induction from the neighboring power circuit are the residual values of current and voltage when unbalanced, abnormal or faulty conditions occur. Among the factors which in turn determine the magnitude of these residuals are: (1) the power circuit voltage, (2) the impedances of the neutral ground connection, (3) the line and apparatus impedances, (4) the fault and earth impedances, (5) the character of ground wires, if used, and (6) the circuit configuration, including ground wires. Much emphasis is placed by those who are advancing the co-ordination of power and telephone systems upon the wide range of values of earth conductivity and its influence in fixing the magnitude and range of action of inductive influences. It is largely this factor which hinders a predetermination of relationships in advance of the actual construction and operation of the circuits of the two systems. There is, consequently, a call for better methods of measurement to disclose those aspects of earth conductivity which will give reliable indication of the disturbance imparted to an extended exposure of telephone circuits.

The methods of limiting the magnitude of power line faults to ground must be regarded as of prime importance in attacking low-frequency induction. The direct benefits of neutral impedance in reducing induction are not, in the opinion of H. M. Trueblood, fundamental objects of research, since to a large extent they can be calculated with all the precision necessary in practical work. One question, however, is the relative importance of induction from unbalanced voltages and from charging currents; the latter tend to increase as neutral impedance is increased. Induction from short-circuit current, though neutral, however decreases with increased neutral impedance.

The real problems involved in the use of neutral impedance as a measure of co-ordination are admitted to be those created in the power system. The possibility of overvoltages, relaying difficulties, system stability and stresses on equipment are some of the operating difficulties presented by the use of neutral impedance. Double faults may be the result of the overvoltages arising from the drop through neutral impedances. Or a single fault may be allowed to persist because relays give uncertain response with the neutral impedance in circuit.

It was the opinion of H. S. Phelps that ground wires do tend to increase fault currents, but that the beneficial effect of shielding usually exceeds the detrimental tendency toward increased fault current. The earth itself is a potent factor in determining whether a mere proximity becomes an inductive exposure. Both parties will need to concentrate on determination of earth values. L. P. Ferris concurs in this recommendation.

A plea was made by M. D. Hooven, H. A. Holmes and H. S. Phelps for a recognition of the fact that the papers presented at the inductive co-ordination sym-

posium constitute the most concise, comprehensive and intelligible treatment available. There is little excuse now for power executives not appreciating the significance of the inductive problem, its bearing on trends and the reverse bearing of trends upon the progress of inductive co-ordination. The essential thing is that the analysis be construed as emphasizing above all other factors the necessity for advance planning of all plant extensions in both systems in the light of inductive co-ordination in order that the present meritorious amicable relations shall be sustained and made the basis for further effective and economical adjustments.

▼

Welding made easier

Improved equipment reduces training period for welders and simplifies technique
Arc theory clarified.
Production problems tackled.

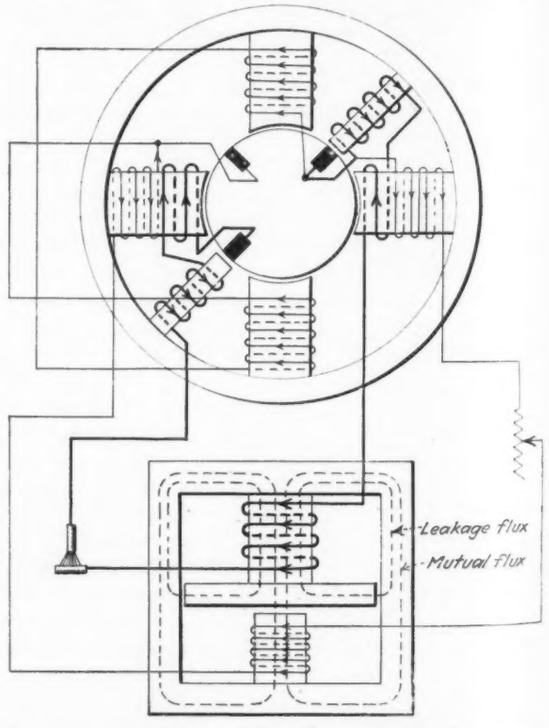
TWO big problems confront the proponents of electric welding as a structure and machine fabricating medium. One is the comparative uncertainty surrounding the character of the completed weld, the other is the difficulty in rapidly training men in the technique of welding. To the latter problem a major portion of the welding session at the A.I.E.E. convention was indirectly devoted. New machines, sponsored by both General Electric and Westinghouse, are so designed that the characteristics of the arc at starting are greatly improved and the weld is rendered less susceptible to formative porosity. Because of the ease of operation, less time for the training of men to meet the limitations of earlier equipment is necessary.

Fundamental research into the basic nature of welding arc phenomena was reported upon in a paper prepared by G. M. Shrum and H. G. Wiest, Jr. Experiments were made with arcs in argon and other gases in which the current was controlled by means of a kenetron. By varying the temperature of the cathode in the kenetron, volt-ampere characteristics of the discharge for the transition from glow to arc, or the reverse, were obtained. Observations of the transition stage between the two types of discharges indicate that at low pressures the abnormal cathode fall rises to very high values and then, as the current is increased, the drop across the electrodes decreases, and this continues until the discharge eventually has all the characteristics of an arc. The results do not support the assumption that it is a temperature effect at the cathode, and the resulting thermionic emission, which causes the glow discharge to go over into an arc. The indication is rather that it is a matter of current density at the cathode. That such a study should have been made of the arc itself, rather than of the machine, was highly commended by J. Slepian, who placed the tendency to inquire into the machine rather than the arc in most studies upon the basis of seeking the easiest rather than the best way.

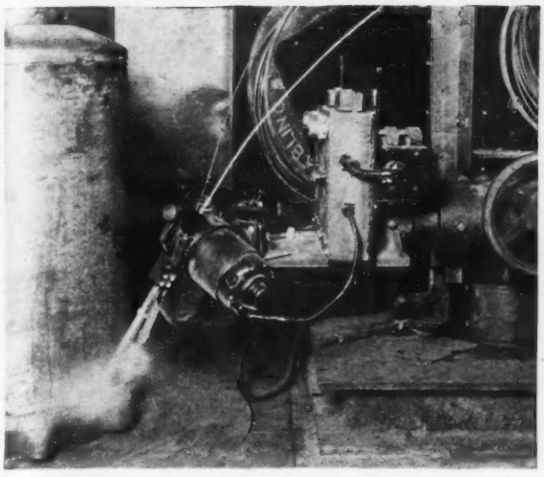
Tackling the welding generator as a fertile source of possible improvement, J. H. Blankenbuehler endeavored to eliminate the trouble encountered in starting the arc and in having it extinguish itself too readily by developing a generator in which the initial surge in striking the arc is eliminated. This was done by producing a neutralizing voltage by means of a transformer with the primary in the welding circuit and the secondary in the field circuit. In addition to increasing the ease of striking and maintaining the arc, this tends to decrease the porosity of the weld which is caused by the sudden flow into molten metal of a large increase in current, such as occurs upon vaporization in the weld metal upon short circuit.

This neutralized welder was also reported upon by F. Creedy, who, upon the mathematical basis, analyzed it as a means of controlling transients and offered a detailed study, from the same basis, as to what he thought occurred during spluttering. Mr. Creedy advocated a stability ratio which might be adopted to characterize the qualities of welding machines. This he would define by means of a standard test in which the welder is loaded up to its maximum load on a resistance, the resistance short circuited, thereby instantly short circuiting the terminals of the machine through the steadying reactance, and the maximum current kick measured. The stability ratio would then be the ratio of this maximum kick to the normal full load current.

Another new system for achieving similar results was offered by S. R. Bergman of the General Electric Company, whose plan involved a transforming reactor containing two windings, a primary connected in series with the arc and a secondary connected in series with the shunt field of the cross-magnetic circuit. The function of the transforming reactor is to provide a magnetic coupling external to the generator between the arc circuit which will be opposite in effect to that between the two circuits within the generator. The generator is self-excited, requiring no exciter. It has inherent regulation suitable for arc welding. The transforming reactor serves the dual purpose of eliminating transients in the generator



Generator with transforming reactor improves welding by stabilizing arc
(Bergman)



Automatic welding of circuit-breaker tank· stationary welder, moving work

and supplying reactance to the welding circuit. Experiments have shown that this combination welds with great ease both for hand and automatic welding. It lays down the metal with ease and accuracy under all conditions met in welding, producing welds of uniformity and strength.

J. C. Lincoln of the Lincoln Electric Company raised the question, in discussing these neutralized generators, as to the pertinency of his observation that welds made in street railway practice, where the trolley line is tapped and where energy conditions closely parallel those which these new generators are designed to produce, should be generally poor in a rating of weld quality. This was replied to by Mr. Blankenbuehler, who expressed doubt that conditions were really parallel, since he felt that in railway welding surges did occur, and in his opinion conditions encourage the welder to draw tremendously long arcs, with consequent impaired weld quality.

Mr. Lincoln also referred to the value of fluxed electrodes in improving arc and weld conditions and cited examples of their proved value. Other speakers corroborated his estimate of their significance.

The application of welding to the production problems of equipment fabrication continues apace, often dominated by the demands of industry for lower production costs and aided by greatly improved results. Malcolm Thomson of the General Electric Company described a method of making motor frames using rolled plate in place of castings. This application of electric resistance welding has resulted in two direct production savings, leading to a better product at lower cost. The frames themselves are produced more economically and machinery expense has been minimized. The frame production charges are reported as 25 to 50 per cent cheaper than corresponding steel castings, with the added advantage of much greater uniformity in dimensions and structure.

Electricity is now applicable to the production of brazed joints. These are seen as possessing the following advantages over lead-soldered joints: Increased factor of safety, saving in time, reduced cost, reduced size, and increased accessibility of joints for inspection. Samuel Martin, Jr., of the General Electric Company described process details and necessary equipment. Silver alloys constitute the brazing medium, and results, in a measure, depend upon choosing the right alloy for the particular type of production involved.

▼

Research on commutation, oil and impregnated paper

Dielectric loss due chiefly to conduction. Whitehead proves three successive conduction stages in dielectrics. Better commutator performance under way.

RECENT results of studies regarding the characteristics of insulating oils and impregnated paper constituted the feature of the research session. Interest was also displayed in two new methods of securing better commutating conditions. A new method of traffic control was presented, although it did not fall in the category of research.

At frequencies lower than 300 cycles per second and at temperatures greater than 25 deg. C. the total dielectric loss may be accounted for by conduction only, declared H. H. Race in discussing the characteristics of cable oils. At higher frequencies and lower temperatures the conduction loss becomes small compared to the a-c. loss, which may be qualitatively explained on the basis of Debye's theory of polar molecules.

In mineral oils having lower viscosity than that tested but about the same conductivity, the a-c. loss is negligible at even lower temperatures and higher frequencies than for the more viscous oil. For oils containing larger amounts of polar constituents, such as castor oil or oil-rosin mixtures, the a-c. loss may be appreciable even at commercial frequencies and temperatures.

It is dangerous, the author warned, to draw conclusions as to the characteristics of a material from measurements taken for only narrow ranges of experimental conditions.

In the purest type high-grade oils there are three definite stages of conductivity, reported Dr. J. B. Whitehead: (1) An initial brief, rapidly descending value of the order of 0.004 second; (2) an approximately constant value of conductivity within the interval 0.004 to 1 second; (3) a very slowly decaying conductivity, reaching a constant value only after 30 minutes or more.

The initial dielectric absorption increases with decrease of temperature and is thus associated with the viscosity.

The dielectric loss under 60 cycles alternating stress is definitely determined by the continuous current characteristics within the interval 0 to 0.1 second. The loss at the higher temperatures and for oils having high initial conductivity is completely accounted for by the second stage of conductivity. For the purest and best oils below 60 deg. the alternating loss is completely accounted for by the same stage of conductivity plus the loss computed from the dielectric absorption pertaining to the first stage. At 30 deg. this second component may represent 35 per cent of the total loss.

Apparently the initial absorption, conductivity, and subsequent decay, are in part due to the variety of molecular complexes and groupings occurring in such hydrocarbons, resulting in a heavy, slow-moving type of ion, which is subject to wide variation in properties with the value of the electric intensity and with other external influence.

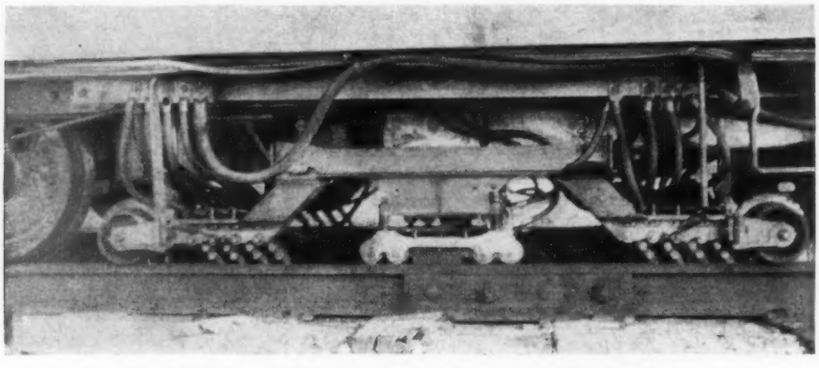
Although presenting only a preliminary report on the fundamental properties of impregnated paper, Drs. Whitehead and Kouwenhoven expressed the opinion that results indicated that they may eventually be able to predict the characteristics of impregnated paper made from paper and oil of known characteristics.

The total dielectric losses in impregnated paper have been separated by the authors into three components—absorption, irreversible and final conductivities, due to fundamental characteristics, which have been studied by means of continuous current measurements. The importance of the initial conductivity of the oil, as distinguished from the final conductivity, was emphasized. Higher conductivity was reflected in increased losses due to both reversible and irreversible dielectric absorption. Emphasis was placed on the importance of the irreversible absorption current in its early stages, as being a true conduction current. This loss may be as high as 30 per cent of the total loss in an oil of excellent insulating properties.

The papers on the characteristics of oils and impregnated papers were discussed as a group by a limited number due to the time available, the comments being chiefly on the accuracy of methods and differences of results.

For example, Mr. Race questioned the accuracy of Dr. Whitehead's conclusions from oscillograms and whether the initial transient is due to the oscillograph or the oil tested. Dr. Kouwenhoven declared that he had secured curved exponential co-efficients of variation of resistance with temperature, instead of the straight lines presented by Mr. Race. He did not agree that direct-current measurements are better and favors letting oil rest before making subsequent tests. C. L. Dawes, commenting on the Whitehead and Kouwenhoven paper, questioned the horizontal power-factor curves inasmuch as the authors have previously shown a rising trend with a change of temperature. S. K. Waldorf explained briefly tests to determine accuracy (plus or minus 3 per cent) of conclusions from oscillograms and pointed out that direct-current impulses failed to produce the initial transient, indicating that it is due to the medium tested and is not a characteristic of the oscillograph.

In closing Mr. Race explained differences between authors by the fact that his results are for higher temperatures and conductivities than the other authors and based on commercial oils. Dr. Whitehead said that the effect accounted for by Debye's theory becomes negligible at low viscosities and frequencies. Dr. Kouwenhoven declared that his power-factor curves do rise slightly with temperature and are not horizontal.



Sperry rail-flaw detector, brush assembly
(Drake)

Methods of securing better commutator performance

A number of tests on commutator machines and slip rings operating in hydrogen was reported by R. M. Baker. The results seem to warrant the following conclusions: A commutator machine designed and adjusted for good commutation in air will operate satisfactorily and give good brush life in hydrogen. If a commutator machine must spark in hydrogen, the brush life may be increased many times by keeping the relative humidity below 10 per cent.

The contact resistance of carbon brushes on a commutator may be lowered materially by the introduction of hydrogen. Carbon or graphite brushes cannot be operated satisfactorily on plain tool-steel slip rings running in hydrogen. The contact drop between a carbon or graphite brush and a brass slip ring may be ten times as high when the ring is running in air as when it is running in hydrogen.

By cutting a helical groove in the face of a slip ring or commutator the following effects are obtained, G. M. Little demonstrated:

It provides a means for forcing a more uniform distribution of current over the brush face, and between parallel connected brushes. It permits the escape of air trapped under a brush. It prevents local spot heating and glowing under overload conditions. It raises the contact drop of the brush, producing better commutation and cooler operation, and in some cases increased brush life.

Experience with a large converter in a hydrogen atmosphere was reported by T. T. Hambleton, who said that an 0.8 per cent increase in efficiency was obtained by reduction in windage and that the rating was increased 25 to 30 per cent due to improved radiation without temperature rise above that in air. Commutation as well as commutator condition were much better than in air.

Owing to the fact that direct-current brushes are usually inspected at least once a week, any method of reducing the attention to once in two or three months is important in hydrogen-cooled machines because of the inconvenience and cost of opening a hydrogen inclosure.

Decisions of the International Electrotechnical Commission at Oslo in July, 1930, with respect to international magnetic units and unit names were briefly reviewed by Dr. A. E. Kennelly (see ELECTRICAL WORLD January 17, 1931, page 141).

A new traffic controller was described by R. C. Hitchcock, the purpose of which is to keep the green signal on the major street except when minor-street traffic demands it. The minor-street vehicle can always get the green signal after a short wait, while the major street receives green light for as much extra time as the minor-street traffic permits. Two experimental horizontal beam installations, which accomplish the above object, are now in operation in Wilkinsburg, Pa. The focused light beam, phototube unit, relay panels, and associated circuits were described in this paper, as were details of the system's operation.

So far as the C. G. S. magnetic units were concerned, the decisions appear likely to meet with general favor, but the series is incomplete and might advantageously be supplemented by at least one name—that for the C. G. S. unit of reluctance, he declared.

The series of units in the practical or volt-ampere-ohm system is also incomplete; but apparently cannot be completed satisfactorily without first deciding two questions: (1) whether the system should be rationalized and (2) whether the M. K. S. or the C. G. S. system should be indorsed. The author recommended that these questions be left for the present undecided, until they have been widely discussed, and illustrative literature developed in aid of international decision.

Many new characteristics appear in non-linear circuit elements, reported Chauncey Guy Suits, when the well-known experiments with circuits having simple series and parallel resonance are performed.

The question was raised whether provision had been made to allow passage of more than one car from the minor street. But the author doubted whether the extra complication would pay for itself, inasmuch as a car on a minor street can gain access to the major street in five seconds.

▼ ▼ ▼

Industrial engineers have special session

Users' viewpoint dominates meeting.
Electron tubes revolutionizing methods of production control.
Energy distribution problems tackled.

ATTENDANCE at the industrial power application session was about equally divided among three classes—utilities, electrical manufacturers, and industrial engineers. All of the papers presented dealt with the industrial-user viewpoint as contrasted with the design of equipment which was discussed at the electrical machinery session. Electron tubes in industry, automatic regulators, electrical distribution for industrial plants and characteristics of two types of synchronous motors designed for high-torque loads were discussed. The papers and discussions were confined to fundamental characteristics rather than separate industries, so that appeal would not be limited.

Advantages, characteristics and applications of electron tubes were discussed by W. R. King. Among the advantages cited were absence of moving parts, and consequently inertia, and response to controlling functions of a low-energy level. The tubes are really more sturdy than they appear. Tube life at rated load runs from 2,000 to 10,000 hours. Cæsium photo-electric tubes are most commonly used because of their sensitivity to the red end of the spectrum.

Applications were discussed involving amplification of photo-electric currents, color analysis, color matching, recording or indicating light conditions and operation as relays, amplifiers and oscillators. In conjunction with photo-electric cells it is necessary to use auxiliary solenoids or contactors; sometimes thyratrons can be used in place of relays.

Use of the photo-cell opens new fields to industries working with colors because the readings obtained from a certain sample constitute absolute identification of its color. Photo-cells have been used to make continuous records of smoke density and for recording temperatures of hot bodies. By far the greatest number of applications of photo-electric equipment are of the type in which an electric circuit is opened or closed in response to a certain change in illumination, such as for turning on and off street lights, signs, and room or factory lights. Photo-electric counters are being used to count automobiles, peoples, steel bars and billets, drops of oil, to initiate operations in bag manufacture, indicate when ore bins are filled, stop traversing motion and advance cutting tool on pipe machines, and replace mechanical limit switches.

The pliotron may be used as a very sensitive relay to respond to the opening and closing of delicate contacts or to contact between an electrode and a conducting liquid. Used as an oscillator the pliotron has been employed in automatic leveling of elevators.

Thyratrons are rated on an average and instantaneous current basis and their life runs from 2,000 to 10,000 hours. As relaying devices they differ greatly from other relaying devices. They may be used as a valve to start d.c. current in a circuit, but cannot readily stop the current flow as long as the anode remains positive. They can be used, though, to start and stop a flow of current if alternating current is applied.

One relaying device has been developed in which thyratrons are employed to short circuit the high-voltage secondary of a series transformer whose primary is connected in series with a resistance welding transformer. The first important commercial installation of thyratron control was made in the Chicago Civic Opera House. In this installation full-wave grid-controlled rectifiers are employed to provide adjustable voltage direct current for saturable core reactors controlling the lighting effects for the stage and auditorium. Similar systems have been applied to other lighting control systems.

The thyratron system may be used to supply small d.c. motor armature power, thus providing motor-speed control by armature voltage variation, somewhat after the manner of a non-reversing, non-overhauling Ward-Leonard system, or it may be used to supply motor field excitation to the conventional adjustable-speed d.c. motors. The speed range which may be secured by

using the thyratron equipment to supply field excitation is limited by the motor itself. The application of this system generally requires that both a.c. and d.c. power be available, since the thyratron equipment operates from alternating current and direct current must be supplied for the motor armature. With the thyratrons at present available for industrial use it is possible to supply armature power for motors up to 5 hp., 230 volts, and field excitation up to 5 kw., 230 volts. Thyratron control is being used to maintain constant tension on a wire-drawing winder. Another installation is being made to control the speed of a motor driving a reel for rubberized belting.

Great increase in industrial applications of electron tubes was prophesied by J. V. Breisky as ratings increase and present and possible uses become better known. In fact, he expects them to be as common as motors eventually. Ruggedness and constancy of performance are characteristics that are being built into tubes for industrial use to distinguish them from radio devices. Cold-cathode tubes are most sensitive, he pointed out, but hot-cathode tubes have higher ratings.

Interesting applications of electron tubes are being made in photometric work, Dr. C. H. Sharp reported. The photo-electric photometer is being used almost exclusively because of its greater accuracy and speed. The cæsium cell with a thin filter has about the same response to various parts of the spectrum as the human eye. By the use of rotating red and blue filters in front of a cæsium photo-cell it is possible, by balancing the responses, to check temperatures within 2 to 5 deg.

Automatic regulators have wide field of use

Uses of automatic regulators in the industries are not so well known, but the progress in this field has been rapid, with the result that there is available a number of different regulators having wide fields of application. The fundamental theory of all regulators was explained by J. H. Ashbaugh.

Any particular regulator design can usually be used for many different applications, such as a speed regulator, current regulator, etc. Regulators can be used to either improve the quality of the manufactured product, reduce the cost, simplify the operation, reduce the amount or size of the equipment or reduce the power bills on purchased power. Load regulators accomplish this latter scheme and can be used in different ways, enabling the industrial plant to make a substantial saving in costs.

One of the greatest needs has been for a speed regulator. One was described which the author considers meets the ideal better than any other device, especially when considered in the light of universal application, speed of response, negligible maintenance and sturdiness. Oscillograms were shown to demonstrate the rapidity and accuracy of the device.

The most recent trend in regulator design has been toward the use of electron tubes. They offer great possibilities in the elimination of moving parts and greater sensitivity. There are many problems concerning their use which must be overcome and upon their solution depends the speed with which they will be accepted in industries. It is felt that rapid strides will be made along this line in the next few years, but at the present time caution must be exercised in their use and application.

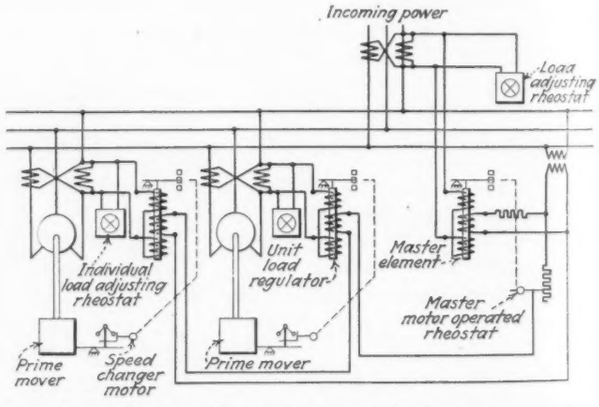
Circuits of other automatic regulators and curves showing how well they perform their functions under practical conditions were presented by R. M. Cruthers, who also discussed their application to load ratio and voltage control.

Methods of maintaining constant steam pressure and frequency with changes in turbine load and steam flow were discussed by R. G. Standerwick, performance curves being presented to prove the effectiveness of the methods. Reference was made to an application of an automatic regulator to a hydro unit in which the unit was brought up to speed from standstill in three seconds and loaded in eight seconds.

Factors that affect industrial distribution

A very comprehensive outline of the elements which must be analyzed in designing the electrical system of an industrial plant was presented by Walter J. McClain. It was divided into two parts: (1) Determining electrical characteristics, and (2) physical arrangement, emphasis being placed on quality of service consistent with economy.

In analyzing the problem, the author pointed out the plot plan of the plant, together with present and future building plans, should be studied for the design of the physical layout of the electrical system. The manufacturing processes and equipment set-ups should be studied to obtain the load data and electrical characteristics of the system. From these studies and the data obtained a digest of the system requirements should be compiled in accordance with the suggestions under each heading discussed. Single-line diagrams with arrangement sketches should be drawn for comparative solutions, ranging from maximum economy of design to maximum reliability or



Load regulator adjusts industrial plant generation for constant incoming power

(Ashbaugh)

continuity of service, with further solutions embodying such features as voltage regulation, power-factor correction and various types of switching equipment.

A comparative tabulation of these solutions should be compiled showing relative costs, losses, space requirements, special building construction, efficiency of operation, continuity of service and maintenance.

The comparative tabulation reduces the various solutions to a basis whereby a final solution may be selected, or effected by compromises of the desirable features of the various solutions.

Commenting on interior distribution and lamp voltages, G. S. Merrill recommended operating lamps at higher than their rated voltage if the maximum illumination per total cost of lamps and energy is desired. Attention was called to two plants in which the lamps were operated at 9 per cent and 25 per cent below rated values at great losses in economy.

Non-metallic sheath cables should be given more consideration in industrial plant wiring, A. B. Smedley declared.

Two types of synchronous motors for high-torque loads were discussed — (1) with a phase-connected damper winding; (2) a modified form of salient-pole motor with squirrel-cage amortisseur using special control equipment.

The first type, presented by M. A. Hyde, Jr., is typified by the following characteristics of two motors, differing in some details:

300-hp., 164-r.p.m., 100 per cent power-factor 2,200-volt, 60-cycle motor

Pull-in torque at 5 per cent slip (per cent)	122
Starting torque with 30 per cent damper resistance (per cent)	230
Corresponding locked kva. (per cent)	396
Ratio starting torque kva.	0.58
Starting torque with 15 per cent damper resistance (per cent)	169
Corresponding locked kva. (per cent)	280
Ratio starting torque kva.	0.60

350-hp., 400-r.p.m., 80 per cent power-factor motor

Pull-in torque at 5 per cent slip (per cent)	118
Starting torque with 25 per cent damper resistance (per cent)	190
Starting kva. (per cent based on 80 per cent power factor)	215
Ratio starting torque kva., 80 per cent power factor	0.88
100 per cent power factor	0.71
Starting torque with 40 per cent damper resistance (per cent)	152
Starting kva. (per cent based on 80 per cent power factor)	166
Ratio starting torque kva., 80 per cent power factor	0.91
100 per cent power factor	0.73
Pull-out torque (per cent)	210

The second type of motor was discussed by D. W. McLenegan and A. G. Ferriss, who presented the following data to show typical torque requirements and the effect of pull-out torque on motor rating at different power factors:

Application	Torque Requirements — Start, Per Cent	Pull-In, Per Cent	Pull-Out, Per Cent
1. Reciprocating compressors (unloaded while starting)			
Air and ammonia (normal)	40	40	140
Low pressure and vacuum pumps	40–80	40–80	140–175
CO_2 compressors	40–90	40–60	150
2. Hydraulic pumps			
Reciprocating (starting unloaded)	40	40	140
Centrifugal	30–40	60–110	150
3. Fans-centrifugal compressors	15–40	50–120	150–175
4. Paper industries			
Pulp grinders	50	50	150
Jordans	50–60	50–60	150
Beaters	125	100	175
5. Rubber industries			
Mixers cracking mills	100–125	100	200–250
Plasticators	100–125	100	150
6. Rock Products			
Ball or Tube Mills	140–150	100–120	150–175
Hammer Mills	150–175	100–120	200–250
7. Coal pulverizers	150–175	100–120	200–250
8. Mining industry			
Ball or tube mills	175–200	100–125	175–200
Gyratory crushers (secondary cone type).. (usually started light, with lower torque)	100–150	100–125	175–200
9. Steel			
Continuous rolling mills	50–100	100	250–350

Pull-Out Torque (Per Cent)	Equivalent Horsepower At Power Factor Indicated — 100 Per Cent	90 Per Cent	80 Per Cent
150	1.0	....	....
175	1.18	....	....
200	1.37	1.37	....
225	1.56	1.54	1.56
250	1.80	1.69	1.69
275	2.02	1.85	1.80
300	2.25	2.05	1.91
325	2.53	2.22	2.02
350	2.79	2.40	2.16

Where high starting and pull-out torques are required it is better to use leading power-factor machines, the authors recommended.

Unless considerable overcapacity is provided in salient-pole synchronous motors having squirrel-cage windings heavy inertia starting loads cannot be handled, declared Frazer Jeffrey, who favored synchronous-induction motors over modified synchronous motors. He declared synchronous-induction motors rated at 150–1,500 hp. have been carrying high inertia loads for several years.

▼

Telegraphy speeds up

Submarine cables are faster.
Concentrator increases efficiency.
Dual lines better overland service.
Test procedures improved, too.

JUST to show that the telegraph engineer had not dropped to the vanguard in the march of technical advance in the electrical industry, the communication men presented an imposing series of wonders, all wrought since they were last prominent in a session all their own several years ago.

A combination of loaded and non-loaded cable, the latter being tapered throughout certain portions, has been laid between Newfoundland and the Azores, offering duplex or two-way operation at a speed of 1,400 letters per minute in each direction. This is said to be the highest speed (greatest service volume capacity) submarine cable in existence. As described by G. A. Randall of the Western Union Telegraph Company, this remarkable achievement was in a large measure due to advances in the technique of balancing against the cable itself an artificial line which closely simulates the impedance of the cable as measured from its end. The balancing of loaded cables, more difficult than that of non-loaded ones, is the fundamental problem in speeding the service. Neither the simplex nor duplex cable has reached its limit of economic development, so that neither has established its definite superiority for all desired operating conditions.

Interference due to the effects of extraneous electrical interference is still a major problem in the design and operation of long submarine telegraph cables and research by Western Union engineers has definitely linked the amount of the interference and the cable speed. The increasing knowledge on this subject is constantly permitting improved service. According to J. W. Milnor, the submarine disturbances are definitely associable with

the times and causes of radio disturbances and research in one field may lead to increased knowledge in the other.

While, as one speaker intimated, increases in submarine communication facility performance was to some measure due to the delicate sensitiveness to speedy messages of the international security traders who indulge in arbitrage, progress in land lines has also been related in no small measure to the necessity of linking Wall Street with many Main Streets. For the last decade or two the speed of transocean signaling is reported to have been multiplied fivefold. Land lines, too, have benefited through the development of the concentrator which, used in central telegraph offices, provides for terminating a large number of start-stop printing telegraph circuits before a smaller number of operators. In effect, this aids in the approximation of the telegraph engineers' ideal of an instantaneous delivery system. Economic savings have also developed for the companies in that, for example, one case showed a saving of 9,000 sq.ft. of floor space in a representative installation involving 1,600 circuits terminating in 608 operating tables. Without the turret-type concentrators 1,000 tables would have been required for the next most efficient system offering comparable service.

Private wire telegraph service has grown rapidly until today the Bell System furnishes 1,500,000 miles of such service. This involves telegraphy for press associations, brokerage houses and large industrial concerns over a plant used largely for joint telephone and telegraph service. Not only may printer service be used for message strip communication but the art permits the printing of interoffice orders on forms of almost any kind positively keyed at sending and receiving points by marginal perforations. "This service," said R. E. Pierce of the American Telephone & Telegraph Company, "will continue to grow and expand, and with the requirements constantly changing it is to be expected that many new and interesting developments will be applied."

▼ ▼ ▼

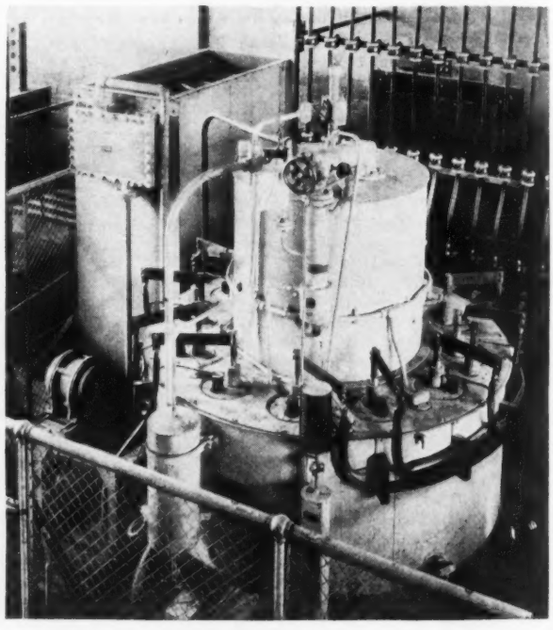
Machinery performance improved by research

Arc-back problem in mercury rectifiers yields to study.
Induction motor operating irregularities linked with nature of slot combinations.

THAT time and money expended in research upon electrical apparatus design and operating performance are well invested appeared clearly during the electrical machinery session, when five analytical papers were presented on recent investigations upon mercury-arc rectifiers, induction and synchronous motors, generators and transformers. A. W. Hull and H. D. Brown pointed out that no theoretical limit to either current or voltage is now in sight for mercury-arc rectifiers. An important mechanical simplification has been secured by using graphite anodes with micalex bushings in place of mercury-cooled iron anodes supported by porcelain bushings. The practical limits of voltage drop (20-40 volts) are generally satisfactory for line voltages of 500 or over, but are too high for 250-volt operation. The hot-cathode rectifier promises to fill this gap. Voltage regulation will be required in the future. This can be accomplished by transformer compounding or by grid control.

Arc-backs coming under control

Rectifiers are now built to withstand arc-backs of less than one second duration without injury. Fast pumps and well-degassed anodes have reduced the time required for vacuum restoration to about one minute and experiments are in progress which are expected to cut this to one second or less. Arc-back may be expected in the future when rectifiers are overloaded beyond capacity (as with other apparatus failures), or in case of mechanical failure of vacuum pumps, water-conditioning apparatus, etc. The use of anode heaters has greatly reduced arc-backs. In the newer rectifiers the heaters are around the anode necks, and are thus at tank potential, and may be operated in series or parallel.



3,000-volt, 3,000-kw. mercury-arc rectifier with anode grid excitation and automatic compounding
(Moreland)

The capacity of rectifiers may be increased almost without limit by the use of small anodes, employing them in parallel for individual phases. Hot cathode rectifiers promise to fulfill future low-voltage application requirements with an efficiency of 95 per cent or better at 250 volts and well over 90 per cent at 100 volts.

Gabriel Kron presented an analysis of induction motor slot combinations as a possible cause of operating irregularities, such as "crawling," vibration, noise and hooks in the speed-torque curve. Dependence on empirical rules for the selection of rotor slots has led manufacturers in the past to the wasteful method of building a series of motors with different slots in bringing out new lines, instead of predetermining these details by

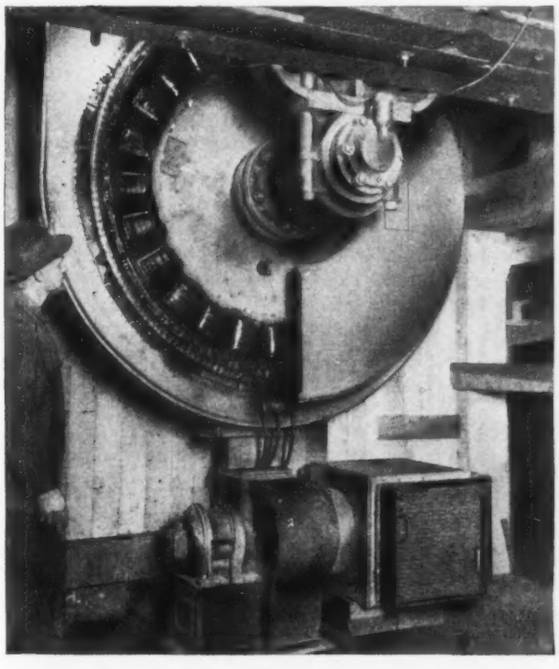
analysis. The author presented a theory of coexisting stationary and rotating slot openings developed with the aid of "revolving permeances." He showed that the interaction of the fundamental flux and a parasitic flux of the same order causes vibrations, objectionable noises and crawling. The existence of these ruinous irregularities depends only on the difference of slots, number of poles, and in some cases on the critical speeds of the rotor for circular or torsional vibrations, and is independent of the number of phases or the type of winding.

H. E. Edgerton and Paul Fourmarier described the application of the integraph to the analysis of salient-pole, synchronous motor performance when starting as an induction motor. From the equation solutions obtained it is possible to determine whether or not any type of salient-pole, synchronous motor will synchronize properly, taking into account inertia, saliency, incompleteness of amortisseur windings, load, switching angle and field current, assuming negligible armature resistance and rotor leakage reactance, no saturation, constant load torque near synchronous speed, and negligible electrical transients.

That auto-transformers can be made non-resonating to meet varied service conditions without radical departures in the construction of windings and shields was shown in a paper by K. K. Palueff, upon "The Effect of Transient Voltages on Power Transformer Design.' The successful operation of all non-resonating transformers (totaling over 1,500,000 kva.) put in service during the last few years makes it desirable to extend the principle of the electrostatic shielding to auto-transformers. Internal stresses, especially between turns, are higher in an auto-transformer than in a power transformer of the same voltage rating. The windings of non-resonating auto-transformers are uniform, free from breaks and the units are similar in appearance and construction to non-resonating power transformers.

In the discussion of the Edgerton-Fourmarier paper Dr. V. Bush announced that a new integraph capable of solving differential equations of the sixth order has been completed at the Massachusetts Institute of Technology, and that this is available for engineering research work in connection with transmission line stability problems and other investigations. It was brought out that the surface has only been scratched in the study of motional and dynamic problems of rotating machinery by stroboscopic and integraphic methods.

K. K. Palueff, commenting on a paper by C. Richard Soderberg on "Heat Flow in Large Turbo-Generators," which analyzed losses by the use of equivalent thermal circuits, pointed out that the use of calculating table methods of studying heat distribution in transformer coils might be applied with success to generator windings. Commenting on Mr. Kron's paper, Prof. L. A. Daggett expressed a need of tabulated information on acceptable slot arrangements, several other speakers also voicing the tendency of the author's rules to eliminate satisfactory dispositions of material.



Inverted synchronous motor meets special industrial drive requirements
(McLenegan-Ferris)

▼

Oiled Pivots Give Better Meter Accuracy

To oil or not to oil meter bearings has long been a prolific topic of discussion. The meter committee of the N.E.L.A. has ascertained the prevailing practice and reported the results of tests on meters with pivot and jewel bearings in a serial report, No. 16-1930, just issued by the National Electric Light Association.

The survey embraced 120 companies and 12,370,992 meters. Approximately 40 per cent are ball-type bearings and 60 per cent are pivot bearings. Only about 19 per cent of the pivot bearings are not oiled at all, whereas 75 per cent of the ball bearings are not oiled, in accord with the recommendations of the manufacturer. The percentages by companies are 30 per cent and 60 per cent respectively.

Five meters were tested at 5 per cent load with all three types of pivots (stainless steel, chrome plated and standard steel) unlubricated and subjected to a relatively poor fish oil and water (to stimulate unlubricated meters in extremely moist climates). After 5,000,000 revolutions the best results were shown by standard steel pivots lubricated with oil; the light load accuracy was consistently 100 per cent after each million revolutions. But with no lubrication it dropped to 98.2 per cent after 5,000,000. The oil-lubricated, chrome-plated pivot gave 99.7 per cent performance at the end. With water lubrication it was, however, superior (99.1 per cent) to the water-lubricated standard steel pivot.

Four fish oils and four mineral oils were tested for acidity, rancidity, moisture absorption, viscosity and freezing. General Electric fish oil and "non-gum" mineral oil were found to be the most satisfactory of the eight oils tested.

Institute President Assails Politics in Business

By W. S. LEE

President American Institute of Electrical Engineers

Public is being ballyhooed at enormous expense.

Muscle Shoals, Hoover Dam and St. Lawrence developments are outstanding examples.

Misuse of public's money can only be avoided by unbiased reports volunteered by engineers.

WE IN America are confronted today with a situation that is fraught with danger, because of the fact that the public may, through partial or insufficient knowledge, reach erroneous conclusions and undertake developments (legislative or otherwise) that would result in our government entering business in competition with its citizens and thus embark upon a course disastrous to the best interests both of those directly affected and of the taxpayers of the country in general.

We are polluted with too much political engineering, political banking, political railroading, and other similar infections too numerous to mention. One of the most dangerous situations that today confronts the engineering fraternity and the public is the mad rush of certain sections to go into political, state, or municipal ownership.

If the varying tide of sentiment for political or public ownership in this country is based upon correct economic and business principles, the theory should be developed and proved, rather than hurried into existence by retaliatory legislation, an over-persuasive press, or communities that are rightly or wrongly disgruntled.

Public overlooks unbiased source of information

I cannot refrain from emphasizing the vital necessity of exercising the utmost caution and care in the consideration of these problems. It is through the engineers, I believe, that a true and proper study of these problems should and will be made.

In these days, when there are so many public or quasi-public operations, it is the engineer's duty to the public to make available his judgment and advice so that the people at large may have the advantage of it in arriving at intelligent conclusions in these matters.

The present national situation is a challenge to the best ability and professional ethics of the engineer—*each engineer.*

Unfortunately for the public at large, unbiased and fundamental engineering information on major projects seldom is broadcast to the public concerning public or quasi-public projects. In the inevitable financing of any project it is usual that only a few of those involved are well informed. If the project be one in which large numbers of citizens participate in public financing, the engineers' reports seldom if ever penetrate beyond the inner circles, except perhaps in modified form. If the project be one which can be handled with the financial assistance of but a few persons, still only a small group gets a real, direct understanding of the importance of the engineer's position and advice. The result is that great projects are designed, constructed and put into operation by but few members of the great general public which in the long run pays all the bills.

If the engineer is capable of designing, constructing and operating these projects, he certainly should be taken into the confidence of the public. His assistance should be invaluable in advising the public as to policy in regard to these developments which play such an important part in the growth and well-being of our country.

It is my wish to emphasize the urgent duty of the engineer not only to convince his brother engineer that his design, construction and operation are right, but to advise the public to the end that it may be adequately and accurately informed; that it may see the fallacies of half-baked political theories, and may avoid developments that would be prejudicial to the public interest. The American Institute of Electrical Engineers always has emphatically insisted that in all his relations the engineer should be guided by the highest principles of honor. It holds that it is the duty of the engineer to satisfy himself to the best of his ability that the enterprises with which he becomes identified are of legitimate character.

Should the government go into business? The more people that work for the government the nearer we approach socialism. I cannot believe that this country is ready to go into socialism; hence why should we be pursuing this policy?

The greatest factor in the development of America has been American initiative—and certainly when the government goes out and competes with its citizens in business the great American initiative will be destroyed. Why should a few members of our government persuade the people to set up competition with its citizens when the citizens actually comprise the government? Why

should an organization created by the people be endeavoring to destroy the people?

If business is in politics every detail will be the subject of terrific political harangue and investigation.

Ex-President Coolidge on January 6, 1931, said in part as follows:

> For wage earners to benefit in time of general depression it would be necessary to assume that government ownership would prevent fluctuations in the business in which it engages. If it is assumed that payment of wages will go on without work, that is not employment, but relief. Then no one should work.
>
> The government has never shown much aptitude for real business. The Congress will not permit it to be conducted by a competent executive, but constantly intervenes. The most free, progressive and satisfactory method ever devised for the equitable distribution of property is to permit the people to care for themselves by conducting their own business. They have more wisdom than any government.

Public ownership in this country and in others, as it has been developed up to this time, by no means has proved that it deserves the support of the people at large; in some instances there have been apparent momentary advantages, but, in the long run, experience has demonstrated the futility of the arguments of those who favor political or public ownership.

For instance, it has been argued that through the exercise of government financing electric power plants and distribution systems could be constructed with cheaper money. However, it is a well-known fact that construction projects under government supervision generally cost at least twice as much as construction projects under private ownership, thus eliminating any advantage from this source.

Again, under political or public ownership and operation those properties concerned usually do not pay taxes, and the revenue that might be derived from them is of necessity transferred to other sources of taxation. This is a matter of such great public concern that in some states a well-defined movement is under way looking toward the taxing of municipally owned utility enterprises.

It is necessary in this discussion to consider some concrete case: Take the much-discussed Muscle Shoals development; why was it built? Does any one know? Certainly not as a war measure, for its actual construction began after the war was over. The nitrate plant located there had constructed a steam plant of a size capable of operating it. This steam plant was within two or three weeks of completion when the armistice was declared. Why did the government *the next year* begin the construction of Muscle Shoals?

I knew and you knew then just as well as we know fifteen years later that it was an unsound venture.

Futility of Muscle Shoals prophesied

In a signed report dated May 18, 1921, to the United States Chief of Engineers my conclusions were given as follows:

> 1. The amount of power estimated by the designing engineer on this work is not correct, nor can it be developed there for practical use. Power cannot be sold as primary power on the basis of average monthly stream flow. Four months' secondary power has no value at present; therefore, the amount of revenue will be materially less than estimated.
>
> 2. Present use of power in the Southern district does not develop more than a 50 per cent load factor. The navigation problems incident to this development are such that this plant will have to be run at approximately 100 per cent load factor in low-water season or waste the water.
>
> 3. Total cost of this development will be $56,500,000. The additional cost over the present expenditures will be approximately $40,500,000. The plant when completed is not worth $30,000,000.
>
> 4. Transmission of power to the systems of the Southern Power Company and the Georgia Railway & Power Company cannot be done in competition with power from other sources.
>
> 5. Power transmission to the systems of the Alabama Power Company or the Tennessee Power Company on the same basis as proposed by the designing engineer would cost these companies twice what they can develop their own plants and produce it for.
>
> 6. There is no present use or need for this development.
>
> 7. The permanent work that has been done should be left as it is, the construction plant salvaged, and the completion of this plant not undertaken until there is developed some use of the power which will require from 80 per cent to 100 per cent load factor.
>
> 8. Except for a small amount of power that could be sold to the companies operating near this plant, it would stand idle for years, with no use for the power.
>
> 9. The loss in discontinuing this work and waiting until some use for power can be developed will be small as compared to the loss of investing a large amount of money in the plant and letting it stand idle for years.
>
> 10. There is no way at the present time that the United States government can get anything approaching a reasonable return on this development if completed.
>
> 11. None of the power companies could afford to purchase power under conditions proposed by the designing engineer, and six of the eight could not afford to purchase at any price, because they can develop or procure their power from other sources at a less price than it will cost to transmit the power from Muscle Shoals to their territory.

Muscle Shoals cannot earn its keep

A review of some of the estimates of cost for Muscle Shoals is startlingly revealed. The development was estimated in April, 1920, to cost $23,800,000—say $25,000,000. Within less than a year this estimate was changed to $50,000,000; now the plant has been partially completed and the cost is approximately $47,000,000, and about half of the generating and hydraulic equipment for the power house remains to be completed.

A private corporation would have built the same plant for less than half that cost.

For any hydro-electric plant to be successful, be it government or private, it must be able to compete by selling power at a cost equal to or less than that produced elsewhere.

Muscle Shoals has less than 100,000 hp. in primary power. In fact, for many weeks during the past year this was less than 65,000 hp. Now, if this plant already has cost approximately $47,000,000 and is still incomplete, it is futile to think of its competing on any kind of a business basis against other sources of power. No doubt many will say that there is a considerable block of secondary power; this is true, but to utilize the secondary power a steam plant must be built, with resultant interest, depreciation, taxes, and part-operating expenses to be provided for. After provision is made for these charges incident to keeping such a steam plant in condition for service, the additional cost of fuel and part-operating expenses with a modern steam plant will be so low that secondary power from Muscle Shoals will not be attractive.

Muscle Shoals has been a colossal political and governmental blunder, but I fear that the next decade will see even greater blunders if some of the projects which are under way now, or projected, are constructed.

If Muscle Shoals, begun nearly fifteen years ago, is today earning nothing and has no policy, what will occur at Hoover Dam? There is a tremendous development started, and nobody knows where it is going. An enormous project already started from the funds of the taxpayers, but without tangible evidence of any definite policy or effective contracts. It is time that these matters be discussed honestly and more frankly by the engineering fraternity with the public to obviate the continuance of these terrific blunders.

Right in the Greater New York area is the greatest aggregation of engineers in the world, and yet serious consideration is being given by the state government to the building of the Long Sault plant on the St. Lawrence River.

Every engineer knows that the government costs of constructing that plant will be two or more times what private costs would be. Further, we know that it is impossible to transmit the power from the St. Lawrence River and make it available to the city of New York in competition with modern local steam plants.

It looks as if the public is being ballyhooed for another Muscle Shoals, only on even a more gigantic scale.

Engineers have contributed largely to the remarkable progress that has taken place in the electrical field during the past four decades, and we should be deeply concerned that no obstacle be allowed to slow down or handicap the economic development which means so much to the American people, from the well to do down to the humblest working man.

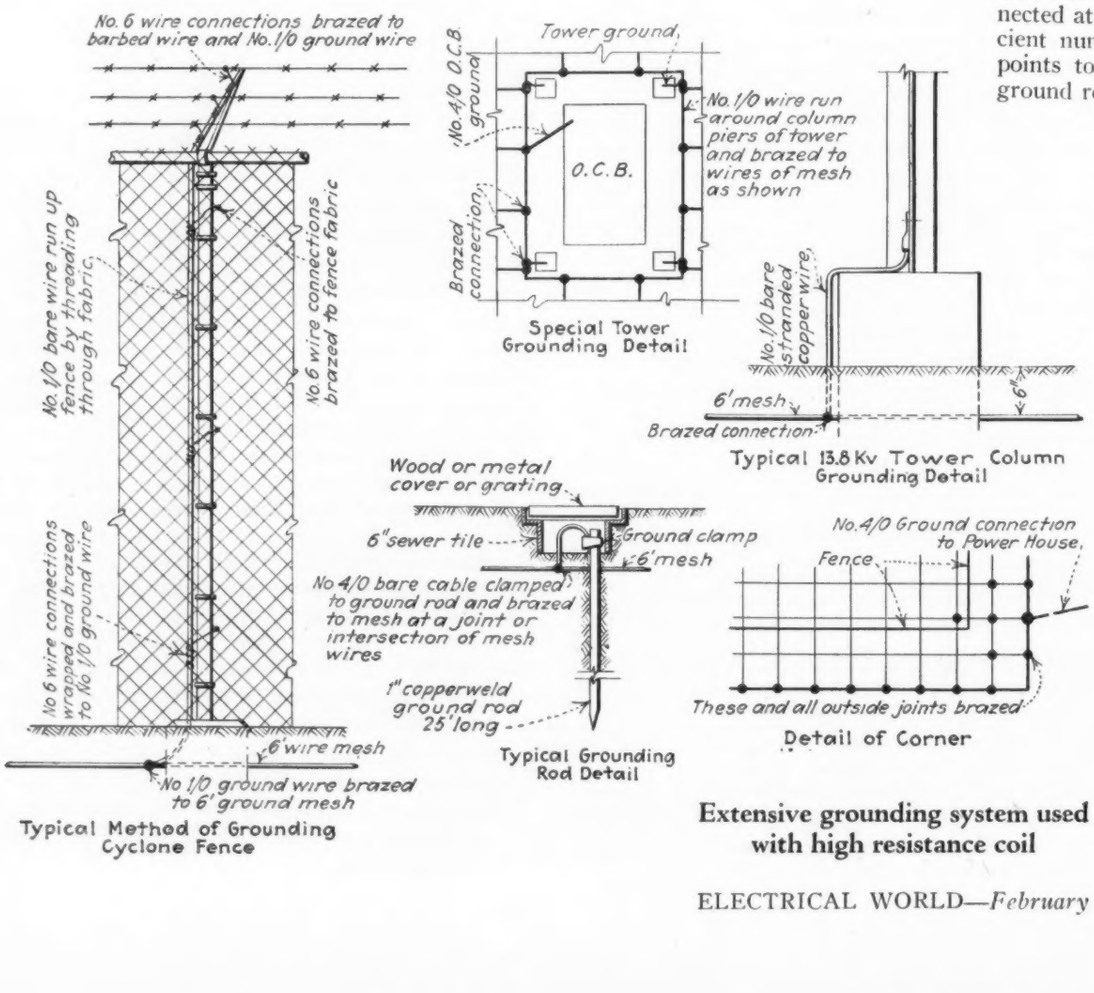
Hence I protest against this dangerous tendency of the day, and I say to each and every one of you engineers:

It is your duty, and mine, both to ourselves and to the public, to use our best efforts to see that the public is correctly and properly advised, for when so advised its conclusions will be sound.

▼

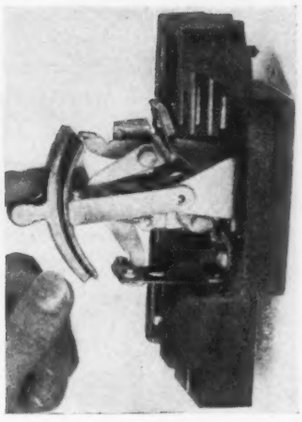
Buried Copper Grid Affords Uniform Ground

Extreme variations of ground resistance, such that potential differences of several hundred volts might occur with a nominal fault current flow between points only a few feet separated, presented a problem in the area selected for the outdoor transformer and switch yard at the Belle Isle station of the Oklahoma Gas & Electric Company. In order adequately to protect the installed equipment it was necessary to have assurance of fairly consistent ground current behavior, and the only way to have such assurance was to reduce the naturally erratic ground resistances to a condition of uniformity. Accordingly, a mesh of No. 1/0 bare copper cable was laid 6 in. below the surface of the yard and extending 10 ft. beyond the fence on all sides. Since the yard is 360 ft. long and 225 ft. wide and the cables are spaced 6 ft. apart, 64 across the yard and 42 lengthwise, the total cable length, including connections to structures, is well over 30,000 ft. and between 5 and 6 tons in weight. The mesh is connected at a sufficient number of points to driven ground rods.

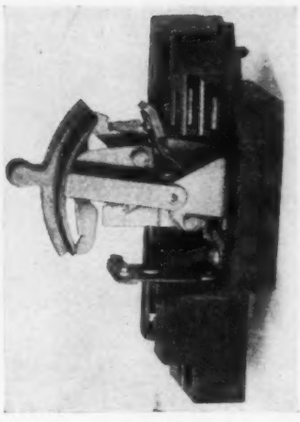

No. 6 wire connections brazed to barbed wire and No. 1/0 ground wire
No. 1/0 bare wire run up fence by threading through fabric
No. 6 wire connections brazed to fence fabric
No 6 wire connections wrapped and brazed to No 1/0 ground wire
6' wire mesh
No 1/0 ground wire brazed to 6' ground mesh
Typical Method of Grounding Cyclone Fence
Tower ground
No. 4/0 O.C.B. ground
O.C.B.
No. 1/0 wire run around column piers of tower and brazed to wires of mesh as shown
Brazed connection
Special Tower Grounding Detail
No. 1/0 bare stranded copper wire
6' mesh
Brazed connection
6"
Typical 13.8 Kv Tower Column Grounding Detail
Wood or metal cover or grating
6" sewer tile
Ground clamp
6' mesh
No 4/0 bare cable clamped to ground rod and brazed to mesh at a joint or intersection of mesh wires
1" copperweld ground rod 25' long
Typical Grounding Rod Detail
No. 4/0 Ground connection to Power House
Fence
These and all outside joints brazed
Detail of Corner

Extensive grounding system used with high resistance coil

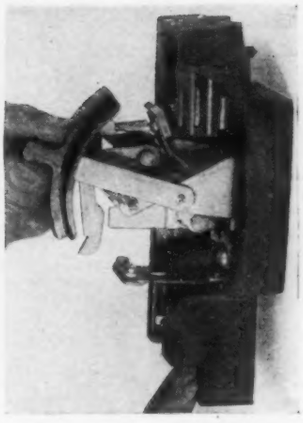
Closed



Open



Tripped



Tripped free against closure

Enter—a New Domestic Circuit Breaker

By FRANK THORNTON, Jr.

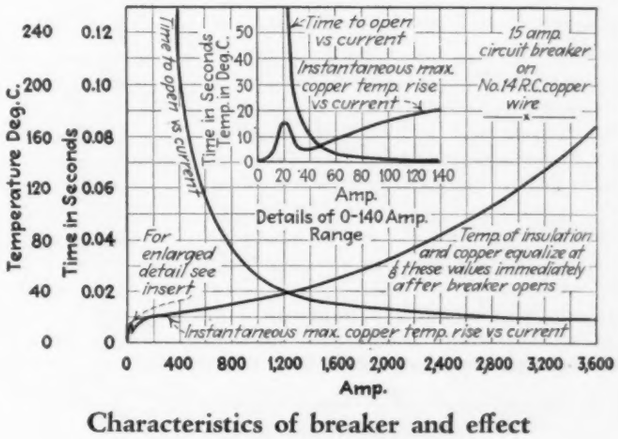
Westinghouse Electric & Manufacturing Company

TO REMOVE the customer inconvenience which usually exists when circuits are overloaded, to reduce loss of revenue from outages, and still assure adequate protection of circuits, a very small, rugged, inexpensive, completely inclosed domestic service circuit breaker, with trip-free overload protection, has been developed by the Westinghouse Electric & Manufacturing Company. This breaker can be reliably made in quantities to sell at a reasonable price.

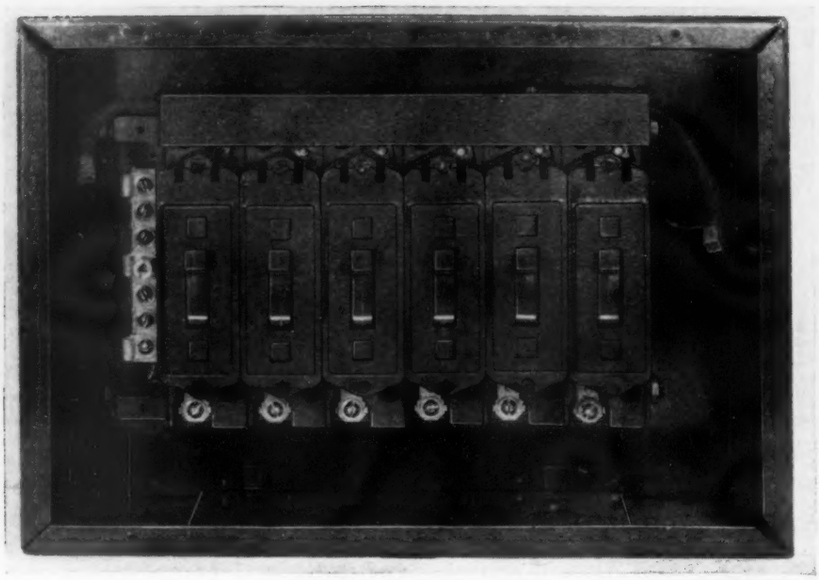
Even before the circuit breaker was designed, it was realized that it should have the following characteristics:

1. Must carry 100 per cent rated current continuously without opening.
2. Must open eventually on 125 per cent rated current; on 200 per cent rated current within one minute.
3. Must open 6,000 times satisfactorily, when operated manually six times per minute, under full rated current and voltage; 50 times at same rate on 150 per cent of rated current and nominal voltage.
4. Must withstand 50 automatic operations as rapidly as possible while carrying 1,000 per cent rated current and nominal voltage.
5. Must successfully open three times in succession with 0.025 ohm in series, on rated voltage (125 volts direct current) from a source capable of delivering 5,000 amp.
6. Must trip free of handle so it cannot be held closed against an overload.
7. Must be safe, not emit sparks or fire.
8. Must be permanent in calibration, and not affected by any of the ordinary conditions encountered in common use.
9. Must occupy no more space than is ordinarily required for the assembly of a tumbler switch and plug fuse.

The design finally developed is illustrated and has the characteristics indicated in the accompanying curve. Studies of the effect which these characteristics would have on the temperature of No. 14 ordinary rubber-



Characteristics of breaker and effect on circuit temperature



Gang of domestic breakers in panel box with cover removed

This new domestic circuit breaker is of a toggle type, with a fixed center mounted on a swinging arm, which is ordinarily latched on a catch on a bimetallic thermal over-current element. As long as this arm remains latched the switch operates as any other toggle switch. But when the current through the bimetal exceeds the limit, and the bimetal bends sufficiently, it releases the latch, the end of the toggle moves out of line and the toggle promptly collapses and opens the switch. The sequence of these operations is shown in the accompanying illustrations.

covered branch circuits, starting cold in each test, indicated the following:

The accompanying curves show the instantaneous temperature of the copper in the wire reached at the time of opening the circuit. The peculiar shape for low current values is due to the fact that below 15 amp. the breaker will not open, and therefore the temperature in the copper rises until the radiation of heat from the surface equals the watts input. But somewhere between 15 amp. (100 per cent rating) and 18.75 amp. (125 per cent rating) the breaker does eventually open. As the current is increased above 18.75 amp. the time of heating becomes shorter and the whole wire does not have time to heat up. As a result the temperature of the copper is relatively much less than it is under normal operating conditions.

However, it was observed that when tested with higher currents where the operating time was short, the copper temperature after cut-off immediately dropped to about one-eighth that observed at the time of cut-off.

The explanation of this phenomenon is that the heat was all in the copper wire and had no time to pass into the insulation. Since the insulation has about eight times the heat capacity of the copper wire, an exchange of heat immediately takes place, cooling the copper down as most of the heat transfers over to the installation. Therefore, on 3,500 amp. the copper wire will heat up 160 deg. C. in the 0.009 second which elapses before the breaker opens, and then the temperature of the insulation and wire will equalize at approximately 20 deg. C. rise. The result indicates that there is an ample margin of safety for the wire under all conditions.

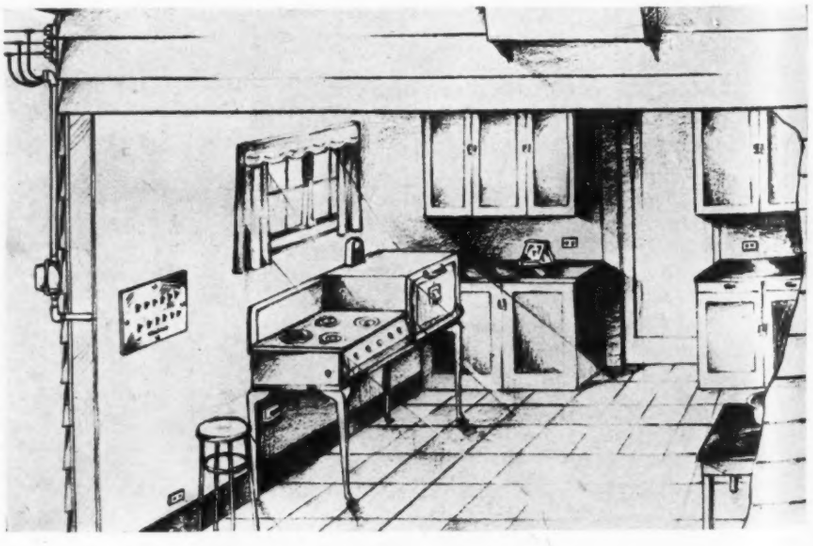
To prevent excessive arcing, the Deion principle of arc interruption is employed. Two slotted steel plates are mounted above the fixed contact. These steel plates are insulated from each other and from the contact. When the breaker opens, the arc is drawn into the slots of the plates and extinguished immediately. The contact on the moving arm is of commercially pure nickel, but the stationary contact is a special metal chosen for its characteristic of not welding with nickel and for its ability to maintain good contact surfaces at all times.

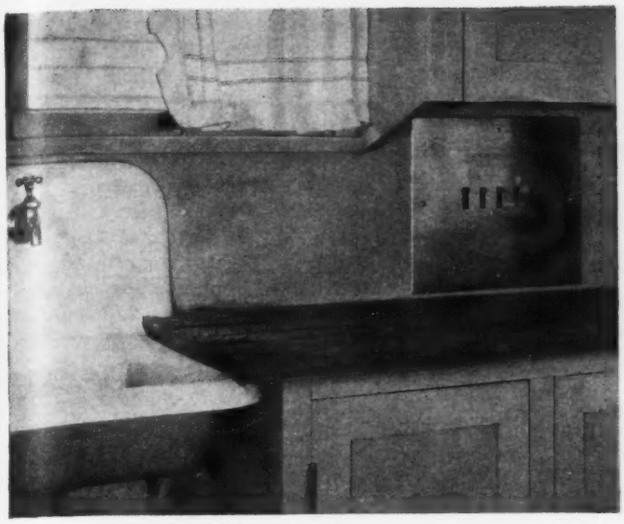
To secure the maximum benefits from this development, it is important to recognize that whether a range is used or not, the load center is in the kitchen, therefore the center of power supply should be in the same location. On this basis the house service drops from the street or alley pole should run in the most direct path to the load center.

A typical six-room house wired on this principle would have the following characteristics:

1. Service wires to side of house under eaves, then in conduit along outside wall under eaves to a point above

Proposed method of house service has seven advantages





Gang of flush type domestic breakers in home load center

kitchen, then down to a point about 4 ft. above kitchen floor.

2. Meter installed out of doors on outside wall.

3. Entrance conduit continues from meter through wall into load-center cabinet.

4. Service wires attached to buses feeding group of circuit breakers in the load center.

5. Ground wire attached to neutral bus and cabinet of load center and continued downward into cellar, where it is attached to water pipe.

6. Branch circuits radiating out from load center as required for range, water heater, appliance branch circuits and lighting branch circuits.

Among the advantages claimed for this system are: (1) Meter is accessible to power company at all times without entering building for reading, testing, removal or replacement; theft of power is avoided; (2) all protective devices are readily accessible to occupants of building, assuring familiarity with their existence; (3) protective devices easily reset without danger by an inexperienced person; no parts to be replaced; no spare parts to be kept on hand; (4) protective devices sealed against tampering except by persons with malicious intent; calibration cannot be altered; (5) minimum voltage drop exists in wiring because path from pole to energy-consuming appliance is reduced to shortest possible length; (6) economical use is made of materials in wiring building; (7) prompt restoration of service is possible at all times without calling in outside help; means more use of electricity and less expense to the power company for service calls.

To give some idea of what installations of these circuit breakers will cost, some contractors have been asked to itemize the prices for installation under three conditions. The itemized figures are omitted because confidential and because they would naturally differ for different localities, but the results are given in an accompanying table.

Relative Wiring Costs for Specific Installations Based on Contractor's Estimates

New Home

Underground service; same number of outlets, circuits, switches, etc., in each case.

Customary Wiring and Switches

85 ft. underground cable—labor and material.....$.....
One 60-amp. switch and fuses.....$.....
One six-circuit attachment and fuses.....$.....

New Plan

On account of underground cable in installation, there would be no saving in material. However, there would be approximately three hours labor saving in wiring the no-fuse load center and outdoor detachable meter in place of the fused switch. This is due to the elimination of the cellar mounting board and the making of the meter loops. **$3 cheaper**

Four-Circuit Installation

Customary Plan

Labor and material for service.....$.....
One 30-amp. switch and fuses.....$.....
One four-circuit attachment and fuses.....$.....
Total cost.....$.....

New Plan

Conduit.....$.....
Wire three No. 8 (45 ft.).....$.....
Service head.....$.....
Fittings.....$.....
Ground.....$.....
Labor—two hours.....$.....
One four-circuit load center.....$.....
Total cost.....$.....

68 cents cheaper

Range Installation

Customary Plan

Labor and material for service.....$.....
One 60-amp. switch and fuses.....$.....
One six-circuit attachment and fuses.....$.....
Total.....$.....

New Plan

Conduit.....$.....
L B fitting.....$.....
Service head.....$.....
Three No. 6 wire (45 ft.).....$.....
Ground.....$.....
Fittings.....$.....
Labor—two hours.....$.....
One six-circuit load center.....$.....
Total.....$.....

$4.15 cheaper

▼

A Sample of Public Relations Advertising

"Complete understanding between the public and the public utilities is vitally necessary. Hoping to contribute its share to this end, the Midland United Company recently published in behalf of its subsidiaries a series of nine informative advertisements in 197 newspapers located in Indiana communities served by subsidiary operating companies."

Thus the Midland United Company, Chicago, Ill., sets forth the reason for an excellent and dignified series of institutional advertising. The subjects treated were:

"Indiana Marches Forward as an Industrial State."
"How a Holding Company Has Aided Indiana's Growth and Progress."
"$142,780,000 Spent by Utilities for Expansions in Indiana."
"State Regulation of Indiana Utilities Protects Customers and Investors."
"How Electric Rates Have Been Reduced in Indiana."
"What Becomes of the Dollar You Pay for Utility Service?"
"Electricity Costs Only 8 Cents a Day for Average Family."
"Public Utilities and Railroads are Indiana's Largest Taxpayers."
"Public Benefits from State Regulation and Holding Companies."

The text of the advertisements were logical developments of the themes stated by the headings, each one of a length of about 500 words. Each advertisement occupied about 14 in. of four-column newspaper space. On account of the size of the space taken it was possible to give excellent typographical treatment to the text and thus remove from it any suggestion of crowding or excessive length.

Need Proper Adjustment of Market Price to Cost*

By CLARENCE L. COLLENS
President National Electrical Manufacturers' Association

THE period from 1914 to 1920 was a period of rising prices and rapidly rising costs, and as usual the price increases lagged considerably behind the increase in costs, which forced the price change. From 1920 to the latter part of the year 1930 the trend has been generally downward, but in the last two months there are indications that the bottom has been reached. Prices of commodities and of many basic materials have been stiffening and there is every reason to believe that the trend of prices for 1931 will be upward.

Where does each branch of the electrical manufacturing industry stand in this picture? Some branches we know have suffered real losses. Some others have just been swapping dollars. Here again the year 1931 will be one of real opportunity, for it is when we are heading out of a depression with prices stiffening generally, especially in the basic raw materials used, that adjustments can be made which will correct any improper uneconomic relation which now exists between the costs and market levels of any electrical products.

This cannot be a N.E.M.A. effort, nor can it be a group effort outside of N.E.M.A., but it can properly result only from individual independent studies by each executive and such adjustments as the facts of any individual business prove to be necessary. No one would be foolish enough to claim that with all the changes that have taken place in the last ten years, and especially in the past year, all the many separate and distinct elements that go to make up the final commercial cost of any electrical product have changed equally, that the change in market levels has merely reflected these changes, or that with all these changes there is necessarily the same or a fair margin of profit and an adequate return on the capital invested.

Analyze all cost elements now

The year 1931 is therefore an opportune time for a thorough review by each executive of all elements of cost and of the trends there have been in all factors of cost and in their relationship between prices and a fair margin of profit. As has been stated, prices have been gradually downward for some time and certain elements in costs have been similarly downward, but certain other elements have surely increased and some elements which have reached bottom will show upward trends in the near future. The year 1931 offers opportunity for group study, not only of proper methods but of certain elements of actual cost. Any such group effort should be undertaken by qualified cost accountants rather than commercially minded executives, if a true, unbiased picture is desired.

The principal factors in cost are material, productive labor, the liquidation of development costs and the various classes of overhead.

In respect to material, there are certain basic materials generally used in each electrical product in which steel and copper are pre-eminent. Have there been any long-trend basic changes in any of these materials which can properly and should be reflected in the cost of the finished products made? In steel we fortunately find an industry with market leaders who have promoted stability and with no evidence of speculation in prices, but this is not true in respect to copper, and we find fluctuation in the base from a peak of 24 cents to a low of 9 cents over the past year and a half. Except where it represents the major element of costs, temporary, uneconomic and violent fluctuations in the base cost of materials should not and cannot be reflected in the prices of the finished product. No one feels that the present low 9½-cent base for copper will last or is more than a temporary condition, but what is the proper long-trend base? What base should be used for copper in reflecting the cost of copper into the products made and into the price of those products?

Are labor costs in line?

Productive labor is another major element in cost. Do you know that your productive labor costs are in line with your competitors, or, if not, what can you do to put them in line? No industry should tolerate inefficiency and no market leader can be expected to hold an umbrella over inefficiency of manufacture. Remember that the long-trend tendency of productive labor costs has been and will be downward. Each must keep up with the procession or go out of business. Also, there are now elements which must ultimately be recognized in productive labor costs—old age pensions, sickness insurance, unemployment insurance, etc. Where this or any part of this is company assumed, it must be financed by the income from the products sold. How is this being reflected in the costs of electrical products at the present time?

Overhead presents another serious problem. Just as the wide temporary fluctuations in basic material costs should not be reflected in the costs from which prices are figured, it is even less possible to reflect current and temporary wide fluctuations in the percentages of overhead, because the current and temporary trend is always against the market demand. The abnormal business of 1929 produced low overhead percentages and the subnormal business of 1930 high overhead percentages, but it is evident to any business man that these temporary changes cannot be reflected in prices.

Overcapacity is also a factor here. There will always be overcapacity. Each company protects itself against normal growth and new productive units are always coming into the market, but how much overcapacity against normal business is there in any group? What is the normal trend or growth of that group, and on what percentage of capacity should normal overheads be figured? Low prices introduced by one competitor, in the hope of filling up his plant to full capacity, thus making a profit and so justifying his price, never produces the desired result and simply initiates an unhealthy, uneconomic situation for all. Each executive should satisfy himself that the normal on which his overhead percentages are based is a true normal in right relation to his individual business cycle and his normal expectancy of growth.

**From an address before the annual meeting of the National Electrical Manufacturers' Association.*

Men of the Industry

Westinghouse Appoints Engineering Executives

SEVERAL APPOINTMENTS of importance have been announced by officials of the Westinghouse Electric & Manufacturing Company:

THOMAS S. PERKINS, formerly manager of supply engineering and consulting engineer, has been made general manager of distribution engineering and will represent S. M. Kintner, assistant vice-president, in his work with several departments. Mr. Perkins has been with the Westinghouse company since his graduation from the Worcester Technical Institute in 1893, advancing steadily since completing his training period. Some of the high spots of his industrial career have been his solution of the complicated problems in the detail and supply engineering departments and his standardization of production and design.

W. M. MCCONAHEY has been appointed consulting engineer, with headquarters in the transformer engineering department of the Sharon works. H. V. PUTMAN succeeds Mr. McConahey as manager of the transformer engineering department. M. S. HANCOCK has been named assistant manager of the industrial motor engineering department, and R. E. MARBURY has been made assistant manager of the supply engineering department.

R. W. OWENS, manager of industrial motor engineering, has been made general manager of industrial engineering and will represent Mr. Kintner in another group of departments. Mr. Owens has been with Westinghouse since he graduated from the University of Illinois in 1915. Most of his work has been in connection with motor engineering and his new position will give him supervision of industrial motor, control, small motor and industrial heating engineering.

▼

ROY WILKINS has been appointed vice-president in charge of engineering of the Pacific Electric Manufacturing Company. Mr. Wilkins joined the organization of the Pacific Electric Manufacturing Company on January 1, 1928, to act in a consulting capacity. For fifteen years prior to that date he had been associated with the Pacific Gas & Electric Company, and at the time of his resignation was assistant engineer in the division of hydro-electric and transmission engineering. Mr. Wilkins has conducted many hydro-electric and high-tension experiments and is well known in the industry for his corona research and his knowledge of high-voltage oil circuit breakers. He has always taken an active part in the affairs of the American Institute of Electrical Engineers and the Pacific Coast Electrical Association.

▼

W. P. Daugherty Succeeds to Superintendency in Wichita

W. P. DAUGHERTY, for the past seven years assistant superintendent of power of the Kansas Gas & Electric Company, has been appointed superintendent of

power to succeed C. Lee Karr, who has assumed new duties in North Carolina. Mr. Daugherty became identified with the Kansas utility ten years ago, after a connection with the Pacific Power & Light Company. Prior to that time he had been associated with the Union Electric Light & Power Company of St. Louis. During the war he was assigned to the inspection of the *Leviathan* for engineering condition, when the government took it over at Hoboken. At that time he was serving in the navy. He received his technical training at the Massachusetts Institute of Technology.

▼

EDWARD J. HOPPLE, assistant prosecuting attorney, Cleveland, has been appointed a member of the Ohio State Public Utilities Commission by Governor George White to succeed Judge William Klinger, Democrat, Lima, who will resign to take his seat on the Fourth District Court of Appeals bench, February 9. Mr. Hopple was educated in the public schools, Heidelberg College and Western Reserve Law School. He was a member of the State Legislature for four terms in the Senate from 1913 to 1916 and a member of the House from 1917 to 1920, serving as Speaker in his last term. The Senate has confirmed his appointment to the commission.

•

P. B. ZIMMERMAN, formerly sales manager of the electric refrigeration department of the General Electric Company, with headquarters in Cleveland, Ohio, has been appointed manager of that department to succeed T. K. Quinn, who has assumed new executive duties. Mr. Zimmerman is a product of the Lamp Works of General Electric Company, having been connected with the Nela Park division for several years and having worked his way up to manager of the sales promotion division, when he left to become sales manager for the company's electric refrigeration department.

•

J. J. O'CONNELL has been elected manager of the Pittsfield (Mass.) Electric Company, to succeed William A. Whittlesey. Mr. Whittlesey, who was succeeded by George W. Lawrence as president of the company last October, will continue his active connection with the company in the capacity of vice-president of the Western Massachusetts Companies, which owns the Pittsfield properties. Mr. O'Connell has been manager of the Western Counties Electric Company at Amherst.

•

WILLIAM J. HAGENAH, vice-president and special counsel of Byllesby Engineering & Management Corporation since 1928, will be the senior member of Cummins, Hagenah & Flynn, the law firm organized to act as counsel for Standard Gas & Electric Company and the public utility properties comprised in its system, as well as for H. M. Byllesby & Company. The firm of Cummins, Roemer & Flynn, which has heretofore acted in this capacity, has been dissolved through the retirement of John H. Roemer and Dennis T. Flynn. Mr. Hagenah is a well-known authority throughout the United States and foreign countries on public utility law, valuations and rates. Prior to his association with the Byllesby organization he was engaged in business independently as a public utility attorney

and consultant, specializing in state and federal commission practice. In 1910 and 1911 he served as consulting expert to the city of Chicago in analyzing and reporting on utility appraisals, audits and rate studies and previous to that was an officer of the Wisconsin Railroad Commission. Mr. Hagenah is a director of several subsidiary companies in the Standard Gas & Electric Company system. A. Louis Flynn, the other member of the firm, has been associated with Cummins, Roemer & Flynn since 1916.

•

IVAN L. SCOTT, in charge of safety work for the National Electric Power Company and the National Public Service Corporation, has resigned to become manager of the insurance department of the Central Public Service Corporation of Chicago.

•

FREDERICK F. BRAND has been appointed managing engineer of the power transformer department of the General Electric Company, Pittsfield, Mass., to succeed F. W. Peek, Jr., recently appointed chief engineer of the Pittsfield works of the company.

•

W. BRILEY WRIGHT, who has been in charge of safety work for the Eastern Shore Public Service Company for the past nine years, has been placed in charge of safety work for the National Electric Power Company and the National Public Service Corporation. Eastern Shore Public Service is a part of the National group.

•

H. N. LISTER, secretary of the Electrical Club of Montreal and of the Canadian Electrical Association for the past five years, has resigned from both offices to take over the management of the Dominion Welding Engineering Company, Ltd. Mr. Lister is an associate member of the Engineering Institute of Canada and of the Corporation of Professional Engineers of the Province of Quebec.

•

ROBERT LEE WILSON, assistant to the president of the Westinghouse Electric & Manufacturing Company, has resigned from that position. The story of his business life is one of those typically American stories of personal success. Step by step Mr. Wilson rose from apprentice to draftsman, to inspector, road engineer, district engineer, superintendent of construction, superintendent of railway construction, assistant general superintendent, works manager, and finally became assistant to the president, his progress during the 37 years of his connection with Westinghouse being constantly and steadily forward. While he will devote himself mainly to his private affairs, he will be retained by the Westinghouse company on call in a consultative capacity, according to the statement made by F. A. Merrick, president of the company, in accepting the resignation.

•

VICTOR R. DESPARD, who has been connected with the electrical manufacturing industry since 1907, has been appointed vice-president of Pass & Seymour, Inc., Syracuse, N. Y. Mr. Despard has had a well-rounded experience in the electrical field, having been with the Mohawk Electrical Supply Company from 1907 to 1909; Pass & Seymour, Inc., in the sales department, from 1909 to 1918; vice-president McGill Manufacturing Company from 1919 to 1928; secretary-treasurer Chicago Mica Company and Fibroc Insulation Company from 1928 to 1930, and now returns to Pass & Seymour as vice-president of that company.

▼ ▼ ▼

OBITUARY

Dr. Luigi Luiggi

SENATOR LUIGI LUIGGI, well-known Italian engineer, died February 1, of apoplexy, in Rome, at the age of 74. Dr. Luiggi was professor of hydraulic and maritime engineering at the Royal University of Rome, Inspector-General of the Royal Corps of Civil Engineers, a director of the State Railways of Italy and a member of Parliament from Genoa, his native city. Dr. Luiggi had been connected all his life with harbors, railways and canals and was familiar with problems relating to transportation. He had traveled extensively in Europe, Australia, Africa, Canada, United States and Argentina, where he lived for many years. Many honors had been bestowed upon him by scientific societies and foreign governments. He was an honorary member of the American Society of Civil Engineers, member of the Institution of Civil Engineers and of the Institution of Structural Engineers of London, corresponding member of the Sociedad Cientifica of Buenos Aires and for three terms of three years each president of the Italian Society of Civil Engineers of Rome. Last year he was awarded a medal by the American Society of Mechanical Engineers at its fiftieth anniversary in Washington. Dr. Luiggi held an honorary degree from Rensselaer Polytechnic Institute, Troy, N. Y.

▼

ROBERT M. NESBITT, chief of the electrical department of the Philadelphia Fire Underwriters' Association, died January 28, at his residence in Upper Darby, Pa. Mr. Nesbitt's service with the association dated back to 1905, when he was appointed inspector of the electrical department.

•

DR. JOHN E. WEBB, safety director for the Interstate Power Company and the Central States Power Company with headquarters in Dubuque, Iowa, died suddenly December 31 near Lancaster, Wis., as the result of a heart attack. He had been safety director of the two companies for three years. Mr. Webb was 57 years of age.

•

HARRY E. DIBBLE, steam engineer at the Seal Beach station of the Los Angeles Gas & Electric Corporation, died suddenly December 23.

•

FRANK I. PEARCE, one of the founders of the Link-Belt Company, Chicago, died in Hollywood, Cal., of pneumonia, in his eighty-seventh year.

•

TIMOTHY F. MULLEN, attorney and formerly counsel for the Illinois Public Utility Commission, died in Chicago, January 23, after a brief illness. Mr. Mullen was born in Aurora 63 years ago.

•

CHARLES H. COULTER, 50 years of age, veteran member of the Southern California Edison Company, Ltd., organization and for ten years manager of the company's Vernon, Calif., district, died January 4 at Los Angeles, Calif. His death was due to pneumonia and followed a brief illness. Mr. Coulter had just been appointed assistant to the vice-president in charge of public relations. His service with the Edison company began 28 years ago, when he worked in Mill Creek power house No. 1, near Redlands, Calif. He later entered the commercial department. Before becoming manager of the Vernon district, where he came to be regarded as an authority on industrial power, he was assistant purchasing agent and also manager in the San Fernando territory. He became manager of the Vernon district in 1919, continuing in that capacity until 1929, when he was made new-business agent in the general office at Los Angeles. During portions of 1910 and 1911 Mr. Coulter was connected with the Great Western Power Company at San Francisco, Calif., as purchasing agent and general storekeeper, and with the Pacific Gas & Electric Company at Phoenix, Ariz., as purchasing agent.

Financial and Statistical News

WHILE many groups of stocks lost ground during January, New York Stock Exchange and Curb power and light stocks gained $194,000,000 for the month. Fourteen representative operating stocks gained a point to 115 during the past week and a group of 23 holding company stocks remained unchanged at 65.9.

——WITH A TOTAL OF $381,000,000, JANUARY FAR OUTCLASSED any previous month on record for power and light company financing. As shown elsewhere, the bulk of this was in mortgage bonds and the average cost of money was substantially lower than for 1930. Short-term financing accounted for only a small part of the total, indicating a belief that money rates are close to bottom.

——THE SURPLUS OF FUNDS IN THE New York money market in January was "larger and more continuous than at any time in a number of years," says the Federal Reserve Bank of New York monthly review. The immediate cause was a reversal of the currency movement.

▼ ▼ ▼

Output Rises Slightly

The average daily production of electricity by public utility power plants in the United States in December was 260,300,000 kw.-hr., nearly 2 per cent, greater than the daily output for November. The normal change is an increase of about 1 per cent.

The total for December was 8,069,-833,000 kw.-hr., against 8,512,000,000 kw.-hr. a year ago, according to the U. S. Geological Survey. These amounts include the output of electric railway and other public utility plants, those for electric light and power producing about 94 per cent of the total.

November output was 6.9 per cent less than in 1929 and 1 per cent less than in 1928; December was only 5.2 per cent below 1929 and was 2 per cent above 1928. In both comparisons, therefore, the operations of the later month are the more favorable.

Some improvement in drought conditions is indicated. For the first time since April the average daily production by the use of water power was larger than in the preceding month; in December it was nearly 4 per cent larger than in November.

▼

Hawaii Has 50,825 Kw.

A TOTAL OF 50,825 kw. installed in nine plants is indicated in a report on central light and power plants in Hawaii, issued by the Electrical Equipment Division, Department of Commerce, and designated as Special Circular No. 605. In addition, fourteen communities are listed as receiving energy at wholesale.

The two largest plants are in Honolulu, 32,500 kw., and Lahaina, 6,350 kw. Only three are rated at less than 100 kw., the majority of the plants being over 2,000 kw.

Predominantly, the service is alternating current, 60 cycle, three phase, 110-220 volts. Steam and hydro turbines are used in generating more than 99 per cent of the output.

The report also lists the light and power plants in Alaska, thirteen in all, with a total rating of 8,024 kw., and the small government plant on the island of Guam.

The standard American plugs and the Edison screw base are used exclusively in the above-mentioned territories.

▼

Canadian Company Makes $12,000,000 Offering

FIRST MORTGAGE SINKING FUND BONDS, series A, of the Maclaren-Quebec Power Company were issued during the first week of February at 94 and interest, to yield 5.93 per cent, a piece of financing involving a total of $12,000,000. These securities, dated February 1, 1931, and maturing February 1, 1961, will be secured by a first mortgage on all the real and immovable properties and immovable rights of the company, now owned or hereafter acquired. The company will have extensive water powers and also reservoir rights on the Lievre River in the Province of Quebec.

▼ ▼ ▼

Insull Discloses Facts on System Financial Structure

AN ILLUMINATING cross-section picture of the financial set-up of the Insull utility properties was presented by Martin J. Insull, president of Middle West Utilities, to the American Statistical Association at the Aldine Club, New York, last week. The system has authorized capitalization of $1,620,-000,000, Mr. Insull said, and of this 39 per cent in bonds and notes, 27 per cent preferred stock and 34 per cent common.

Practically all of the common stock of subsidiaries is owned by holding companies and all other classes of securities, totaling about $1,140,000,000, are held by the public. The market valuation of these securities, however, is about $180,000,000 higher, which leaves the suggestion in the minds of some that the stock is partly based on so-called "water."

Of the total shown, the parent company, Middle West Utilities, has $253,-000,000 capitalization, subsidiary holding companies $387,000,000 and subsidiary operating companies $980,000,-000. Stocks are in the hands of 345,832 shareholders, and Mr. Insull estimated that bondholders number more than 250,000, making a total of around 600,000 individual security holders in the Middle West system.

Something of the magnitude of the system and the service rendered is seen from the fact that gross revenues in 1930 were between $180,000,000 and $185,000,000, of which about 61.5 per cent resulted from electric light and power operations and the balance from ice, gas and other types of service. As of December 31 last the system served a population of 6,361,000 in 4,624 communities in 30 states.

The Middle West group has brought utility service to 1,408 communities that had had no service before and is supplying 321 communities that had had only partial service until Middle West supplied 24-hour service.

Middle West system has 31,235 employees, to each of whom is furnished insurance of $500 to $1,500 at the ex-

pense of the companies, depending on length of service. Under the group plan, employees may purchase additional insurance at their own expense at the same rate charged to the companies. At the end of 1930, as a result, $26,557,500 insurance was in force at the companies' expense and $39,610,000 additional paid for by employees. Through Allied Employees' Investments, Inc., formed by the sytem, employees may subscribe in installments to investments managed by directors chosen from executives of Middle West companies.

In building the system the Insulls have closed down 476 obsolete power plants, which were replaced by large central installations. At the same time more than 35,000 miles of transmission lines were built for links. Subsidiaries of the system interchange power at 75 points and power is interchanged with other utility interests at 221 additional points.

Mr. Insull said the system now operates 321 ice plants with a daily capacity of 14,726 tons of ice.

▼

San Joaquin Light & Power to Buy Midland Counties

APPLICATION FOR AUTHORIZATION of the sale of the Midland Counties Public Service Corporation to the San Joaquin Light & Power Corporation has been filed with the California Railroad Commission. The application was signed by P. M. Downing, as vice-president of the Midland Counties organization; A. Emory Wishon, as president of the San Joaquin, and A. F. Hockenbeamer, as president of the Pacific Gas & Electric Company, which in its ownership of common stock controls both the other corporations. Under the terms of the proposed sale, Midland Counties agrees to transfer all its properties to the San Joaquin for a consideration of 10,005 shares of San Joaquin common stock. San Joaquin, in turn, agrees to assume all obligations of the Midland Counties corporation, including its funded debt.

The Midland Counties Public Service Corporation serves electricity in southwestern Fresno County, southeastern Monterey County, all of San Luis Obispo County and northern Santa Barbara County. While its corporate set-up has been separate, it has from the day of its organization been so closely identified with the San Joaquin Light & Power Corporation that it has generally been regarded as a San

▼ ▼ ▼

CURRENT EARNINGS REPORTS OF ELECTRIC LIGHT AND POWER COMPANIES

OPERATING COMPANIES

	1930	1929	Per Cent Increase	Operating Ratio 1930	Operating Ratio 1929
Alabama Power* (Year ended December 31)					
Gross earnings	$17,910,572	$18,337,201	—2.3	43	38
Net earnings	10,255,878	11,384,200	—9.9	..	..
Arkansas Power & Light (Year ended October 31)					
Gross earnings	8,835,091	8,327,412	6.0	54	51
Net earnings	4,097,106	4,075,979	1.0	..	..
Consolidated Gas, Electric Light & Power of Baltimore (Year ended November 30)					
Gross earnings	28,500,444	27,871,045	2.3	59	58
Net earnings	11,430,109	11,736,303	—2.6	..	..
Consumers Power (Year ended December 31)					
Gross earnings	32,512,049	33,420,539	—2.7	45	48
Net earnings	17,890,394	17,200,462	4.0	..	..
Detroit Edison (Year ended December 31)					
Gross earnings	53,706,926	56,558,279	—5.1	68	66
Net earnings	17,140,979	18,978,304	—9.7	..	..
Georgia Power† (Year ended December 31)					
Gross earnings	24,943,385	23,474,210	6.2	50	48
Net earnings	12,536,951	12,173,045	3.0	..	..
Houston Lighting & Power (Year ended November 30)					
Gross earnings	8,811,174	7,900,233	12.0	52	52
Net earnings	4,213,448	3,745,075	13.0	..	..
Kansas Gas & Electric (Year ended November 30)					
Gross earnings	5,984,631	5,825,669	3.0	52	52
Net earnings	2,852,114	2,772,874	3.0	..	..
Los Angeles Gas & Electric (Year ended December 31)					
Gross earnings	24,115,777	23,902,897	0.9	55	52
Net earnings	10,756,669	11,346,773	—5.2	..	..
Louisiana Power & Light (Year ended November 30)					
Gross earnings	6,067,145	5,189,884	17.0	52	51
Net earnings	2,890,099	2,521,547	15.0	..	..
Louisville Gas & Electric (Year ended November 30)					
Gross earnings	10,571,658	10,271,441	2.9	..	..
Net earnings	5,381,279	5,303,279	1.5	..	..
Memphis Power & Light (Year ended November 30)					
Gross earnings	6,783,173	6,074,188	12.0	59	60
Net earnings	2,788,989	2,401,852	16.0	..	..
Minnesota Power & Light (Year ended November 30)					
Gross earnings	6,476,364	6,215,659	4.0	39	36
Net earnings	3,968,009	3,946,064	1.0	..	..
Mississippi Power & Light (Year ended November 30)					
Gross earnings	5,074,857	3,972,184	28.0	65	64
Net earnings	1,746,865	1,409,537	24.0	..	..
Nebraska Power (Year ended November 30)					
Gross earnings	6,550,173	5,950,389	10.0	49	51
Net earnings	3,338,503	2,926,600	14.0	..	..
New Orleans Public Service (Year ended November 30)					
Gross earnings	17,596,509	16,098,685	9.0	64	64
Net earnings	6,301,309	5,856,457	8.0	..	..
Northern States Power (Year ended November 30)					
Gross earnings	33,146,773	32,674,313	1.4	..	..
Net earnings	16,249,647	16,671,763	—2.5	..	..
Ohio Edison (Year ended December 31)					
Gross earnings	19,207,918	19,384,661	—0.9	39	42
Net earnings	11,669,443	11,217,606	4.0	..	..
Oklahoma Gas & Electric (Year ended November 30)					
Gross earnings	14,485,569	14,072,751	2.9	..	..
Net earnings	6,885,455	6,558,685	5.0	..	..
Pennsylvania Power & Light (Year ended November 30)					
Gross earnings	30,935,577	30,068,963	3.0	49	50
Net earnings	15,763,984	15,047,116	5.0	..	..
San Diego Consolidated Gas & Electric (Year ended November 30)					
Gross earnings	7,380,797	7,328,596	0.7	..	..
Net earnings	3,695,080	3,502,959	5.5	..	..
Tennessee Electric Power (Year ended December 31)					
Gross earnings	14,785,791	14,752,228	0.2	52	51
Net earnings	7,039,289	7,262,828	—3.1	..	..
Texas Power & Light (Year ended November 30)					
Gross earnings	9,962,292	9,831,406	1.0	48	50
Net earnings	5,138,941	4,853,745	6.0	..	..
Wisconsin Public Service (Year ended November 30)					
Gross earnings	5,619,837	5,456,212	3.0	..	..
Net earnings	2,342,549	2,341,200	0.0	..	..

HOLDING COMPANIES

	1930	1929	Per Cent Increase	Operating Ratio 1930	Operating Ratio 1929
American Water Works & Electric & subs. (Year ended November 30)					
Gross earnings	54,417,827	53,859,203	1.0	51	50
Net earnings	26,749,651	26,837,074	—0.3	..	..
Cities Service (Year ended December 31)					
Gross earnings	60,817,832	44,786,447	35.7	..	..
Net earnings	58,307,813	43,452,387	34.2	..	..
Commonwealth & Southern & subs. (Year ended December 31)					
Gross earnings	141,656,531	147,370,482	—3.9	48	49
Net earnings	72,684,117	75,406,181	—3.6	..	..
Engineers Public Service (Year ended November 30)					
Gross earnings	53,035,497	50,494,852	5.0	56	58
Net earnings	22,955,347	21,350,147	7.5	..	..
Federal Light & Traction (Year ended November 30)					
Gross earnings	8,526,944	8,477,145	0.6	56	59
Net earnings	3,708,078	3,450,249	7.5	..	..
Philadelphia Company (Year ended November 30)					
Gross earnings	61,863,399	63,405,158	—2.4	..	..
Net earnings	30,168,007	30,980,129	—2.6	..	..
Public Service of New Jersey & subs.‡ (Year ended December 31)					
Gross earnings	138,161,946	137,086,707	0.8	68	69
Net earnings	43,410,344	41,830,768	3.8	..	..
Standard Gas & Electric & subs. (Year ended November 30)					
Gross earnings	153,809,957	153,566,642	0.1	..	..
Net earnings	73,377,248	73,393,499	—0.0	..	..

*Figures for 1929 include operations of gas properties sold May 1, 1929.
†Figures for 1929 include operations of gas properties sold May 1, 1929. Operations of Columbus Electric & Power included from May, 1, 1930.
‡Depreciation included in operating expenses.

Joaquin subsidiary. It has been under the same ownership and management. It owns no generating plants, purchasing all electric energy at wholesale from the San Joaquin company. The Western Power Corporation, which operated the Great Western Power Company of California, acquired control of the San Joaquin and Midland Counties corporations in 1924. Subsequently it disposed of its holdings in the three companies to the North American Company. Their control passed to the Pacific Gas & Electric Company early last summer, when the North American Company retired from the operating field in California, becoming the largest individual stockholder in P. G. & E.

▼ ▼ ▼

Bond Market Absorbs New Issues Readily

THE buoyant tendencies of the bond market in the face of an unusually heavy load of new issues suggests that these new issues are being readily absorbed. The shelves of dealers have been fairly well cleared of old material. Inquiry among banking and brokerage houses on this last point indicates that while there is a certain margin of undigested securities, the boards were perhaps clearer early in the year than they have been for a long time.

Since January 1 the volume of new public issues has been well over $550,000,000 and the total for power and light companies alone was over $376,000,000, which far exceeds that for January, 1930. About 80 per cent of the January, 1931, total was in the form of bonds, while more than 80 per cent of last January's total comprised debentures and notes. There is a large volume of financing to be done in the next few months and bankers offer the opinion that this can be done readily when and as the market shows further signs of recovery, but warn against overburdening the current market.

The current effect of money rates on bond prices, a factor certainly to be considered, has been emphasized by Dr. George W. Edwards, economist, of Stone & Webster and Blodget, Inc. Dr. Edwards says:

It is worth while to compare the yield on these bonds with the rate on commercial paper and to note the spread at the present time as compared with previous years. This comparison is seen in the following table, which gives a comparison of the rate on four to six months' commercial paper, the yield on high-grade bonds and the spread in December, 1930, and in past years:

	Yield 4-6 months Com'c'l Paper per Cent	Yield on 60 Bonds per Cent	Spread per Cent
June, 1900	3.69	4.15	0.46
June, 1904	3.60	4.25	0.65
June, 1909	3.25	4.32	1.07
April, 1914	3.73	4.57	0.84
May, 1916	3.13	4.55	1.42
August, 1922	3.91	4.81	0.90
September, 1924	3.13	4.78	1.65
January, 1928	3.88	4.38	0.50
December, 1930	2.88	4.62	1.74

Average week ending December 19.

From the above table it is seen that the spread between the rate on four to six months' commercial paper and the yield on high-grade bonds in December, 1930, was 1.74 per cent, approximately the widest spread in any period since the beginning of the century. In the money market funds naturally tend to flow either into commercial paper or into bonds, depending upon the comparative yield between these two forms of assets. As seen in the statistics in the above table the yield on bonds is more attractive than the yield on commercial paper.

In recent weeks, the average yield for the 60 bonds had declined to 4.42 per cent, but at the same time commercial paper rates have been reduced to an average of about 2.62 per cent, with the result that the current spread is approximately 1.80 per cent.

NEW SECURITY ISSUES OF ELECTRIC SERVICE COMPANIES IN JANUARY

Name of Company	Amount of Issue (Par Value)	Period (Years)	Class	Purpose	Interest Rate	Price	Per Cent Yield
Public Service Co. of New Hampshire	$1,000,000	26	First and refunding mortgage gold bonds, series B	To reimburse for purchase of properties, for extensions and for other corporate purposes...	4½	96	4.76
Pacific Gas & Electric Co.	25,000,000	29	First and refunding mortgage gold bonds, series F	To retire certain bond issues and for additions and betterments to company's properties	4½	98	4.62
Detroit Edison Company	34,984,000	30	General and refunding mortgage gold bonds, series D	Refunding	4½	100	4.50
Tennessee Electric Power Co.	7,000,000	25	First and refunding mortgage gold bonds	To reimburse in part for the cost of improvements, extensions and additions	5	99	5.05
Puget Sound Power & Light Co.	9,000,000	1	Secured gold notes	To refund maturing bonds, to discharge obligations for plant additions and for other corporate purposes	4½	99¾	4.75
Texas Power & Light Co.	4,000,000	25	First and refunding mortgage gold bonds	Construction	5	99	5.07
United Gas Improvement Co.	24,500,000	..	Preferred stock	To retire floating debt and to provide additional capital for general corporate purposes	5	98	5.10
Columbia Gas & Electric Corp.	50,000,000	30	Gold debenture bonds	To reduce bank loans, and to provide funds for capital expenditures and for other purposes.	5	98	5.13
Arkansas Power & Light Co.	3,000,000	25	First and refunding mortgage gold bonds	To reimburse the company for property additions and acquisitions and for other corporate purposes	5	98	5.14
Milwaukee Elec. Ry. & Light Co.	15,000,000	40	First mortgage gold bonds.	To reimburse treasury for funds expended for refunding purposes and for property additions	5	100	5
Standard Gas & Electric Co.	10,000,000	4½	Convertible gold notes.	To acquire ownership of certain securities and for other corporate purposes	6	100	6
Buffalo General Electric Co.	20,000,000	50	General and refunding mortgage gold bonds, series B	Repayment of short-term indebtedness and for other corporate purposes	4½	101	4.45
Houston Lighting & Power Co.	4,000,000	47	First lien and refunding mortgage gold bonds, series D	To retire bonds, to reimburse for construction expenditures and for other purposes	4½	92½	4.90
Kansas City Power & Light Co.	27,000,000	30	First mortgage gold bonds.	To redeem bonds and to provide funds for other corporate purposes	4½	102¾	4.33
Philadelphia Electric Co.	40,000,000	40	First and refunding mortgage gold bonds	To redeem underlying bonds and to reimburse in part for property acquisitions and additions and improvements	4	93½	4.34
North American Co.	25,000,000	30	Debentures	To provide funds for payment of company's floating debt and for general corporate purposes	5	97	5.20
Eastern New Jersey Power Co.	1,260,000	28	First mortgage gold bonds.	To reimburse for additions, extensions and additions to properties and for other corporate purposes	5	99	5.06
Total	$300,744,000			Rights	$80,908,365		
Total amount actually realized	295,801,400			Total financing for January	376,709,765		

Business News and Markets

Unemployment Management Problem, Just as Profits Are

BUSINESS management is assuming the responsibility for continuous employment of its workers, Col. Arthur Woods, chairman of the President's Emergency Committee for Employment, told the National Conference of Business Paper Editors at the Hotel Commodore, New York, last week. Colonel Woods outlined what has already been accomplished toward eliminating unemployment. He said in part:

"What we are beginning to feel is that, arising out of this and earlier depressions, we have the beginning of a new economic era of quite a different kind; the era in which business management realizes its responsibility toward the continuous employment of the producing unit, which is also the consuming unit. Business men know today that their employees are also their customers.

"Public works, exclusive of federal, for example, for which the budget reaches the stupendous total of three and a quarter billion dollars in a normal year, are this year just about where they would be in normal times.

"The significance of this fact lies here. Federal public works normally total about $250,000,000 a year. For 1931, to help out in our present emergency, the budget has been extended to $700,000,000—almost tripled, that is to say. If state and municipal programs could also be extended during an emergency, through careful planning and restraint during normal times, it is easy to see that this would go a long way toward filling up any depression.

"In the emergency we now face the practical thing is to push whatever construction of a public or semi-public nature is now in sight. We know that of this type of work $3,053,000,000 worth is now in sight, and of this amount $1,221,800,000 worth can be started in the next few months. So our committee is concentrating on the putting into operation of projects which have reached what one may call the pick-and-shovel stage.

"Public works, then, constitute a great lever which the country as a whole can bring to bear against unemployment when it threatens.

"No matter what the form of industry may be, no matter what the individual problem of stabilization may be, a continued high level of employment is a problem to the management just as profits are. Even a 5 per cent gain in the reduction of unemployment, besides reducing human misery, would mean millions of more dollars in purchasing power in this country. When unemployment exists it deals its blows not only at its victims among the workers but also among their former employers. The new spirit that is leading industrialists to keep all the workers they can is not based on humanitarianism. It is based on business good sense.

▼

Kelvinator Net Profit Shows Substantial Rise

NET SALES OF Kelvinator Corporation for the year ended September 30, 1930, amounted to $21,450,896, against $21,947,344 for the same period a year previous, a decline of less than 2.3 per cent. Cost of goods sold and selling costs amounted to 4 per cent less in 1930 than the previous year. Net profit thus amounted to $1,601,016, against $1,221,384 the year before, or an increase of over 31 per cent.

The balance sheet on September 30, 1930, shows cash on hand in excess of all current liabilities. Working capital on September 30, 1930, was $5,960,295, after the purchase during the year of $925,000 of the company's gold notes and $181,000 of first mortgage bonds of Electric Refrigeration Building Corporation and the expenditure of $736,673 on additional plant facilities. Assets of the corporation and subsidiaries were in excess of $17,000,000.

▼

Power Consumed in Canada Up 10 per Cent Yearly

SOME INTERESTING OBSERVATIONS on the growing use of electricity in Canada are contained in a year-end review of the electrical industry by D. C. Durland, president of the Canadian General Electric Company, Ltd. He says, in part:

Records show that the average increase of central-station power consumption in Canada is about 10 per cent per annum. This growth is accounted for by new plants and extensions in the mining, pulp and paper and other industries and by the constantly increasing use of radios, refrigerators, household cooking and heating appliances, motor-driven labor-saving devices and equipment for the electric lighting of residences and buildings of all kinds. If there is an inclination to underestimate the potential demand for electrical energy for such uses, it may be cited that the new radios alone installed in Canada last year will consume something like 22,000,000 kw.-hr. of electric power annually. New electric refrigerators which were purchased last year require an additional 15,000,000 kw.-hr. to operate them.

The industrial field offers spectacular demonstrations of the use of electricity. The pulp and paper industry, for instance, while not displaying the same phenomenal growth as in the last few years, uses about 20 per cent of all electric power produced. The mining, metallurgical and chemical industries rank among the largest users of electric power. Last year such

▼ ▼ ▼

DELINQUENT ELECTRICAL ACCOUNTS

(National Electrical Credit Association)

Number of Accounts Reported

Division	December 1929	December 1930	Per Cent Increase or Decrease	12 Months 1929	12 Months 1930	Per Cent Increase or Decrease
New York	274	249	— 9.1	3,081	3,318	+ 7.7
Middle and Southern Atlantic	161	97	—39.8	1,945	1,796	— 7.7
New England	92	108	+17.4	1,519	1,376	— 9.4
Central	643	611	— 5.0	7,865	8,259	+ 5.0
Total	1,170	1,065	— 9.0	14,410	14,749	+ 2.4

Total Amounts Reported

	December 1929	December 1930	Per Cent Increase or Decrease	12 Months 1929	12 Months 1930	Per Cent Increase or Decrease
New York	$63,837	$33,490	—47.5	$597,134	$512,310	—14.2
Middle and Southern Atlantic	17,925	31,068	+73.3	260,617	290,591	+11.5
New England	12,508	11,690	— 6.5	211,171	173,761	—17.7
Central	90,382	74,101	—18.0	954,213	1,040,251	+ 9.0
Total	$184,652	$150,349	—18.6	$2,023,135	$2,016,913	— 0.3

Wage Cuts Retard Recovery

By JOHN E. ROVENSKY
Vice-Chairman Bank of America

MANY believe that wage reductions are part of the solution—I doubt it. It is difficult to reconcile the statement that we have overproduction with the contention that reducing the purchasing power of millions is desirable. An individual manufacturer, looking only at his own problem, feels that if he reduced wages he might be able to stimulate sales. He could if all the rest of the world remained unchanged. But it wouldn't. Other employers would likewise reduce wages, and sales would remain the same or decrease.

I shall not attempt any prophecy, but I think it is safe to venture to say that business has certainly not become poorer since the last few months of 1930 and we have had occasional improvements since then that are encouraging. The business of the country is like an airplane that alighted last fall, is now bouncing along the ground and bids fair soon to be taking off. But we must not expect a rapid ascent. The airplane has a heavy load of troubles and can do no zooming, so improvement in business will be quite gradual.

well-known steel companies as the Algoma Steel Corporation at Sault Ste. Marie, Ont., and the Canadian Tube & Steel Company at Montreal made extensive installations of electrical apparatus.

▼

TRADE BRIEFS

Knapp-Monarch Company, manufacturer of electrical household appliances, has moved from St. Louis, Mo., to Belleville, Ill. The company has taken over the former National Carbon Works plant.

•

Illinois Testing Laboratories, Inc., Chicago, Ill., announces the appointment of James H. Knapp Company, Los Angeles, as its exclusive Pacific Coast distributor of its products for industrial purposes.

•

Sale of a Westinghouse 500-hp. wound-rotor type CW hoist motor to the Southern Coal & Coke Company has been announced by the Westinghouse Electric & Manufacturing Company.

•

Trumbull Electric Manufacturing Company, Plainville, Conn., announces that the name of the A. G. Electric Manufacturing Company will be changed to the Trumbull Electric Manufacturing Company. The Pacific division, with manufacturing plants, will be located in Seattle and Los Angeles.

•

General Electric Company has named T. K. Quinn chairman of the newly constituted appliance sales committee. Other members of this committee are: J. E. Kewley, manager of the incandescent lamp department, Nela Park; C. E. Wilson, newly elected vice-president; P. B. Zimmerman, manager of the electric refrigeration department, and G. A. Hughes, president of the Edison General Electric Appliance Company, Chicago. The announcement concerning the company's home appliance sales committee has far-reaching significance inasmuch as the new committee will co-ordinate all the selling activity of General Electric Company appliances, including General Electric refrigerators, radios, ranges, washers, water heaters, lamps, vacuum cleaners, clocks, sun lamps, heating devices and table appliances throughout the country.

•

The Dampney Company of America, Boston, Mass., announces the opening of a direct company branch office in Chicago, Ill.

•

Ohio Brass Company, Mansfield, Ohio, announces the appointment of Pirelli S. A., with offices in Rio de Janeiro and São Paulo, as Brazilian agent for that company in South America. Pirelli S. A., a branch of the Pirelli Company of Italy, maintains an extensive selling organization throughout Brazil.

▼

New York Metal Prices

	Jan. 28, 1931 Cents per Pound	Feb. 4, 1931 Cents per Pound
Copper, electrolytic	10	9⅞
Lead, Am. S.& R. price	4.75	4⅞
Antimony	7⅛	7.05
Nickel, ingot	35	35
Zinc, spots	4.40	4.40
Tin, straits	25.80	26
Aluminum, 99 per cent.	23.30	23.30

▼ ▼ ▼

N.E.M.A. Will Collect and Distribute Statistics

THE decision to collect and distribute to its members quarterly statistics on billings, factory stock and field stock of various classes of refrigerators was made at a meeting of the refrigeration division of the National Electrical Manufacturers' Association in New York, January 22. Louis Ruthenburg of Copeland Products, Inc., was unanimously elected chairman of the division.

Consideration also is given to adopting as a recommended practice a uniform warranty on refrigerators. The committee on commercial practices was instructed to review a form of warranty which the division had previously considered in 1929, but which had not been formally adopted because it was not thought entirely satisfactory. After review it will be brought back to the division for final consideration.

In view of the desirability of having a standard method of rating for commercial machines the division voted to refer this matter to the technical committee for study, this committee to refer its recommendation to a joint committee of its members and members of the committee on commercial practices.

A proposed method of specifying gross and net cubic content and shelf area, tentatively prepared by the division in 1929, was referred to the technical committee to be brought up to date.

A report was made that the American Standards Association is planning to give wide distribution to its recently issued safety code for mechanical refrigeration. The A.S.A. plans at an early date to distribute to interested officials in principal cities a manual explaining the code and advantages of its adoption and containing a copy of the code itself.

It was voted to hold regular meetings of the division on the fourth Wednesday of each month and the next meeting was set for February 25 in Detroit.

Interest was expressed in methods of testing domestic refrigerators. It was voted to apply to have the N.E.M.A. representation increased from the present one to three individuals on the American Standards Association subcommittee which has this matter under advisement. This is subcommittee No. 3 of sectional committee B38.

Market Conditions

INQUIRIES show a decided increase in the Pacific Coast area and a sharp increase in residential building has expanded demand for materials. Staple power apparatus business is slow, however, though buying of heavy transformers and machinery has revived.

——EASTERN BUSINESS, ALTHOUGH SHOWING SIGNS of substantial growth, is far from satisfactory, buying being confined to current demands. Some improvement is noted in sales of motors in the New England area.

——A CONSIDERABLE VOLUME OF BUSINESS IS PENDING both in the Southeast and the Middle West districts, but there is a tendency to delay actual commitments.

▼ ▼ ▼

PACIFIC COAST

—WHOLESALERS REPORT *a marked increase in inquiries and projects under consideration, as well as a gradual, though very slow, increase in actual business. Recent building construction includes much residential work and also industrial and miscellaneous jobs ranging from $50,000 to $250,000, which is just the kind desired last year to fill the valleys between the outstanding major projects.*

—RETAIL BUSINESS IS BETTER, *being influenced by specials on percolators and other hollow-ware, by new designs of established lines, such as the fan-type radiator, and by the gathering momentum of the 1931 power company campaign.*

Small staple power apparatus items are slow, though there is much buying of heavy transformers and machinery. A good packing and canning year is forecast by many $25,000 to $100,000 construction and betterment jobs to plants in the main and coast valleys, but in general industrial plants are still conspicuous by their lack of even maintenance purchases. Railroad business is fair and includes period requirements of wire and wiring material, and an underground conversion job in the Reno yard. Miscellaneous orders include a $4,000 lead cable award for Los Angeles, a $3,500 varnished cambric for the same, a $32,000 street lighting award for Los Angeles, electric ranges, kitchen equipment, and machinery for Fort Mason, San Francisco, and a $15,000 steam welder for a Los Angeles steam plant.

Prospective business is excellent and includes electrical requirements for Glendale estimated at a carload of transformers, a carload of hardware, $8,000 worth of meters, $500,000 worth of equipment and machinery for various substations on the west side of the San Joaquin Valley in the Fresno district, a suggested order for floodlights for Glendale street lighting aggregating $125,000, with such major projects as a $1,500,000 San Francisco apartment house, Congressional appropriations of $4,000,000 for California hospitals, and a $1,000,000 expenditure for United States naval and marine plants at San Diego.

General resumption of logging operations in the Pacific Northwest is freely predicted within the next 30 to 60 days, with reopening of lumber mills generally to follow. Inquiries from these sources are reported fair to good, but actual sales are at absolute minimum. Motor sales last week included twenty from 25 hp. down to a mill manufacturing concern, ten machines, including two 100 hp. and two 40 hp., to a sawmill in Grays Harbor and about 30 small sizes for spraying machines in orchards. Specifications are being written for about 25 motors from 50 hp. down for a $700,000 hotel in Yakima and the Ford Motor Company is expected to place an order shortly for about $50,000 worth of motors for a $3,200,000 assembly plant just started in Seattle. An order for between $15,000 and $20,000 worth of panel and switchboards for the same plant will be placed by the Newberry Electric Company of Los Angeles, holder of the electrical contract. The latter-named contract approximates an outlay estimated at $150,000.

CONSTRUCTION PROJECTS

Southern California Edison Company, Los Angeles, Calif., has plans under way for addition to steam-operated electric generating plant at Long Beach, Calif., to cost $7,500,000. San Joaquin Light & Power Corporation, Fresno, Calif., plans transmission lines to Wilson and Corcoran substations to cost over $450,000. Southern Sierras Power Company, Riverside, Calif., will build a transmission line terminal at power plant at San Bernardino, Calif., to lightning arresters. Inquiries are out cost over $200,000. Tucson Gas, Electric Light & Power Company, Tucson, Ariz., plans extensions in steam-operated electric power plant to cost over $300,000.

NEW ENGLAND

—SLIGHT GAINS IN MOTOR SALES *are noted during the past week; one prominent manufacturer recorded a small-motor order amounting to over $100,000 and a fair demand for single motors. Inquiries for industrial equipment as yet reveal little evidence that indicates other than cautious buying on the part of manufacturing industries.*

Scheduled materials are moving fairly well. Special control equipment orders recently reported by one manufacturer include materials for a prominent broadcasting station amounting to about $12,000. Interest in supplies for marine needs is active in this district. Illumination for outside purposes, featuring special lighting for service stations, is attracting attention. Negotiations for heavy electrical machinery are quiet, though one interesting order will soon be placed for heavy power equipment and negotiations are still pending for a waterwheel and generator for a western Massachusetts power company.

CONSTRUCTION PROJECTS

Norwich University, Northfield, Vt., plans addition to science building to cost $300,000. United Electric Light Company, Springfield, Mass., has plans for power substation at East Springfield, to cost over $750,000. Treasury Department, Washington, D. C., is considering new central postal station at Boston, Mass., to cost $2,000,000. Watertown, Mass., will soon take bids for an administration building and police station to cost $150,000.

❖

SOUTHEAST

A CONSIDERABLE AMOUNT *of business is pending, both industrial and central station, and a satisfactory portion of this is expected to be placed during the coming week. However, much of this central-station business is for stock. Inquiries continue to show an increase and the general volume of small orders is reasonably good.*

The only outstanding order placed last week was from the coal and iron interests in Birmingham and called for $215,000 worth of motors and control equipment for a plating mill. A Georgia central station ordered bare and weatherproof wire costing approximately $30,000. Some other power company orders were for $3,100 worth of creosoted pine poles, three 333-kva. transformers and $2,100 worth of lightning arrestors. Inquiries are out in Georgia for substation equipment which will probably total $60,000 and this business should be placed within the next ten days. An industry in

Georgia has signed a power contract which will involve the purchase of $7,000 in electrical materials and equipment, a 150-kva., 44-kv. substation and the construction of ¾ mile of transmission line.

CONSTRUCTION PROJECTS

W. F. Culbert & Sons, Inc., Marion, Va., has approved plans for an electric-operated asphalt-mixing plant to cost over $65,000. Northern District Warehousing Corporation, Carrollton, Ky., plans tobacco redrying plant to cost close to $50,000. Louisville & Nashville Railroad Company, Louisville, Ky., is reported planning expansion program at terminal and port at Pensacola, Fla., to cost more than $1,000,000. Alabama Power Company, Birmingham, Ala., plans extensions and improvements in number of power substations of 44,000-volt rating, including additional equipment, to cost over $100,000.

❖

MIDDLE WEST

—GENERAL BUSINESS *in the Middle West section appears to be maintaining its position, although not without difficulty. The volume of business has not increased to as great an extent as looked for by some of the most optimistic individuals, nevertheless a definite improvement in general conditions seems well under way.*

Reports from the major industries indicate some improvement, while the automotive industry is showing an increase in production. A considerable amount of municipal work, involving the purchase of several million feet of wire and cable, with the necessary labor of installation, to cost approximately $2,000,000, is up for consideration. The various utility companies are in the market for quite a large amount of apparatus and their construction programs are quite comprehensive. Some of the interesting items placed this week include seven carloads of asbestos lumber, one carload of fiber conduit, six 150-kva. and ten 200-kva. single-phase overhead type transformers, one water-cooled furnace floor, construction of exterior of substation to cost $35,000 and 140 light type automobiles valued at $80,000.

CONSTRUCTION PROJECTS

Frank Hamachek Machine Company, Kewaunee, Wis., has filed plans for an addition to cost $75,000. Duluth, South Shore & Atlantic Railway Company, Duluth, Minn., plans ore dock at Marquette, Mich., to cost $1,750,000. Michigan Electric Power Company, Bad Axe, plans substation and extension in lines at Lapeer, Mich. Northern States Power Company, Minneapolis, Minn., will proceed with superstructure for local steam-operated electric power plant to cost over $2,000,000. Citizens Power & Light Company, Council Bluffs, Iowa, plans extensions in transmission lines in Mills County. Iowa Southern Utilities Company, Centerville, plans extensions in transmission lines in Grinnell.

EASTERN

—CONTRACTS FOR *electrical equipment in the Eastern district, while developing a stronger tone, continue on a scattered basis, far from satisfactory. Commitments from central stations generally are on a reduced rating, with here and there a worthwhile order; immediate buying holds tenaciously to current demand. The same holds true in regard to industrial business, with iron and steel account the best prospect at the moment.*

—RAILROAD AND MARINE *orders are showing up better, with the government an important factor in the latter line. Wire and cable are securing only casual attention, although the prospects are growing better in connection with projected transmission line construction throughout the country.*

Three bids, all in excess of $500,000, have been tendered for the construction of four turbine units for a 10,000-ton cruiser to be built at one of the government yards, these being from the Westinghouse Electric & Manufacturing Company, New York Shipbuilding Company and the Capstaff-Hunter Turbine Works, Inc.; an early award is expected. The first noted company has secured an important commitment from the Manitowoc Shipbuilding Corporation for a geared turbine drive for a large tug boat for Great Lakes service now being built for the Great Lakes Dredge & Dock Company; this will be the first vessel so propelled in the Great Lakes territory, and will use steam at the highest pressure ever attempted for a boat of this type.

The New York Edison Company is placing contracts for buildings and equipment for expansion at its East River generating station, with total investment reported at $5,000,000. A New York manufacturer has secured a contract from a metropolitan central station for a quantity of transformers and network protectors to cost about $100,000. The Westinghouse company has secured an important commitment for about $250,000 worth of equipment for the new hydro-electric generating plant now being built by the New-Kanawha Power Company, covering requirements for switchgear, with a ten-panel auxiliary station switchboard, high-tension oil breakers, switching apparatus, etc.; this company is furnishing four waterwheel generators of 30,000 kva. capacity for the plant on a contract previously received.

CONSTRUCTION PROJECTS

United Electric Light & Power Company, New York, contemplates installation of additional equipment at Hell Gate steam-electric power plant. Sinclair Consolidated Oil Corporation, New York, will carry out expansion program at oil refining plant at Sinco, near Houston, Tex., to cost over $3,000,000. England-Walton Company, Philadelphia, Pa., contemplates leather tannery at Olean, N. Y., to cost over $350,000. Columbia Railway & Navigation Company, care of Murray & Flood, New York, engineers, has plans for hydro-electric power project on Santee River, near Furgeson, S. C., to cost over $10,000,000. Pennsylvania Railroad Company, Philadelphia, Pa., contemplates a union terminal at Atlantic City, N. J., to cost close to $6,000,000, and will proceed with a produce terminal and distributing plant at Baltimore, Md., to cost $400,000. Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will receive bids until February 17 for one electric frequency changer for Philadelphia navy yard (Schedule 5047). Bureau of Yards and Docks, Navy Department, Washington, D. C., will receive bids (no closing date stated) for a 2,500-kw. turbo-alternator, with direct-connected exciter, for Philadelphia navy yard (Specification 6392). General Purchasing Officer, Panama Canal, Washington, D. C., will receive bids until February 21 for electric motor, transformers, insulated wire and cable, etc. (Panama Schedule 2630).

❖

SOUTHWEST

—WHILE THERE HAS BEEN *no marked change in business conditions in this district, the general feeling continues good. Orders for apparatus are coming in steady volume and manufacturers say that January business is a little better than last year.*

Utilities have not opened up very strong on 1931 budgets, but there is renewed activity in nearly all lines and numerous inquiries are coming in to the manufacturers and jobbers. The only order reported of any size is for a lot of motors for a 2,500,000 bushel grain elevator in the western part of Missouri. It covers thirteen synchronous and thirteen induction motors, all to cost $38,000.

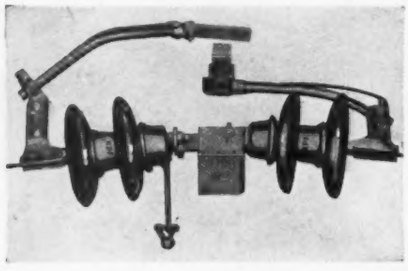
CONSTRUCTION PROJECTS

Public Utilities Consolidated Corporation, Goodland, Kan., has plans for addition to steam-operated electric power plant to cost $75,000. Oklahoma Gas & Electric Company, Oklahoma City, Okla., plans 66,000-volt transmission line from Spiro, Okla., to Fort Smith, Ark., about 20 miles. Hudson & Duggar Company, Little Rock, Ark., plans barrel heading mill to cost over $75,000. Central Power & Light Company, San Antonio, Tex., has plans nearing completion for a hydro-electric power plant on Rio Grande River, Eagle Pass, Tex., to cost over $1,000,000. Tidewater Interurban Railway Company, Houston, Tex., recently organized, plans electric railway line from Houston to Port Arthur, Tex., and vicinity, to cost $5,000,000, including power substations and lines. New Orleans Public Service, Inc., New Orleans, La., plans extensions in underground cable system in business district to cost about $80,000.

New Equipment Available

Contact Clips Held by Adjustable Toggle Bolts

A NOVEL CONTACT which consists of a pair of clips held in position on the switch arm by means of two adjustable toggle bolts has been announced by the K-P-F Electric Company, San Francisco, Calif. The insulators adjust themselves to the sag of the line wire and still maintain perfect contact in all



positions of normal sag, it is claimed. The strain is taken on a pivot point bearing so that the friction is reduced to a minimum. Dead-end clamps are an integral part of the switch and bolted pressure joints between the line and the switch conductor give full line-carrying capacity to the switch.

Each pole of the switch is completely self-contained, being only loosely connected to the adjacent leg through the connecting rod. Warping or twisting of the crossarm does not affect alignment. Only one crossarm is required, and with this dead-end arrangement no extra line material of any kind is required, according to the manufacturer, which makes the installation cost extremely low.

▼

Insulated Aluminum Wire and Cable

A VARIED LINE of insulated aluminum wire and cable under the trade name "Alectral" has been announced by the General Cable Corporation, Pittsburgh, Pa. The initial group of insulated aluminum conductors includes such constructions as network cable, underground cable, insulated line wire, tree wire, armored cable, magnet wire, starter cable and car wiring cable. A new departure in connection technique has been developed, together with the required fittings and accessories. Connections will be made by applying high pressures to sleeves by means of a specially designed light-weight hydraulic press.

For applications in which tensile strength is not a prime consideration the conductors of "Alectral" wires and cables are all aluminum. For aerial service, in which tensile strength in relation to resultant loads is of major importance, certain stranding combinations of aluminum and steel have developed.

Recent tests have demonstrated that the system disturbance due to underground short circuits is less with aluminum than with other conductor materials. Then, too, "Alectral" cables will run cooler under a given load, since their larger conductor cross-section results in greater heat radiation.

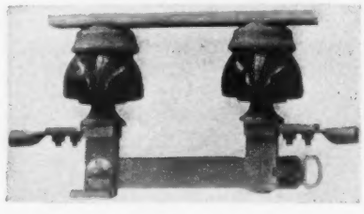
▼

AN IMPROVED FEATURE in the Horolectric time switches in which the motor has more power and greater accuracy has been announced by the Horolectrical Corporation. The switch mechanism is of a new and more powerful design, 15,000 watts capacity. The switch box is larger, giving more room for wiring. It is cadmium coated, making it a lifetime protection against rust and corrosion. Horolectric time switches are electrically or hand wound, to meet every requirement. The electrically wound time motor is not affected by line fluctuations or interruptions and will run three days on its reserve. Power is furnished with 60-amp., 250-volt, double-pole, quick-acting arc-snuffing switch.

▼

Disconnect Has Positive Safety Lock on Blade

A LINE OF OUTDOOR single-pole, hook-stick-operated, 4.5-kv., 300-amp. disconnecting switches for inverted mounting has been announced by the Delta-Star

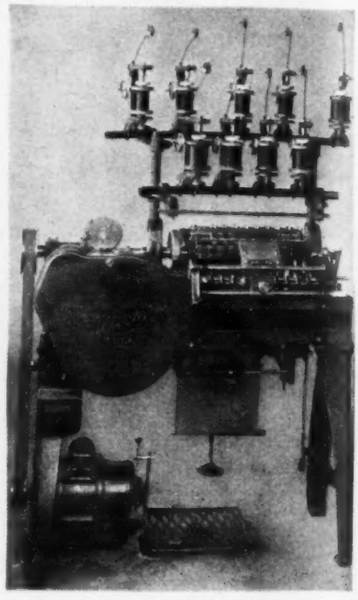


Electric Company, Chicago, Ill. A distinguishing feature of this design is the use of a positive safety lock on the blade and contact clip and a holding lock on the hinge end which firmly secures the blade in open position.

▼

Automatic Winding of Paper-Insulated Coils

AN AUTOMATIC WINDING MACHINE, type 104, for paper-section coils, has been announced by the Universal Winding Company, Providence, R. I. Fully



adjustable, it can readily be set to handle different types of coils, using any size of wire from No. 20 to No. 40 (B & S gage), and by means of a variable transverse cam the machine will produce any required length of wire layer from $\frac{1}{4}$ to 5 in.

An interesting feature is the manner in which the insulating paper is handled. An element is injected between the wire layers at high speed, without interruption to the normal winding rate.

▼

AN ELECTRICALLY HEATED COMMUTATOR SOLDERING MACHINE has been announced by the P. E. Chapman Company, St. Louis, Mo. The electric heating elements have been designed to have the durability of the burners used on this company's gas-heated machines and to withstand accidents and abuse just as well. They are equipped with an easily adjustable, clearly indicating, automatic temperature control. It is claimed that productions with this machine are very great because the segments of the commutator are soldered all at once.